

# Carlsbad Caverns May Provide Clues To Groundwater Recharge in Desert Southwest

Hundreds of feet below the surface of the earth, the cave is perfectly quiet except for the sound of an occasional drop of water splashing on the rocks. Now and then, a barely perceptible wind current moves the air, the only sign that this dark, secluded place might be connected with the outside world.

Here in the deep, where sunlight never penetrates, a Sandia geologist patiently collects drops of water as they fall from fissures, stalactites, and other cave formations

**As a storm mass travels over land and precipitates, the heavier molecules are the first to fall.**

before they splash onto mineral deposits or crystal-clear subterranean pools. His work is illuminated by the flashlight on his helmet.

His purpose: to work jointly with the National Park Service to determine the seasonal effect of surface precipitation on the replenishment of groundwater in the Chihuahuan Desert, one of many water-starved regions of the American West.

The place is Carlsbad Caverns in southeastern New Mexico. The scientist is Steve Lambert of Geochemistry Div. 6233.

The 800-foot-deep cave provides a natural passage to the subterranean realm. It eliminates the need to drill a hole to gain access to the normally dry layer of earth through which rainwater percolates on its way to the underlying water table.

Once a month for the next four years, Steve will collect samples of water from a dozen or more dripwater sites. He will pour the samples into tightly capped bottles to prevent evaporation, and transport the bottles to Albuquerque for scientific analysis.

The research is funded by the geosciences re-



STEVE LAMBERT (6233) records observations made while taking a dripwater sample just to the side of Green Lake, a natural pool in Carlsbad Caverns. (Photos by Mark Poulsen, 3162)

search program of DOE's Office of Basic Energy Sciences.

Because the site is so pristine, every item Steve carries underground must be rustproof so as

not to contaminate the natural cave environment. Virtually every piece of equipment — graduated cylinders, ring stands, even the paper in Steve's notebooks — is made of plastic.

### Using Isotopes to Trace Rainfall

Since the 1950s, scientists have known that rainwater contains naturally occurring isotopes of hydrogen and oxygen. These isotopes are deuterium, an atom with twice the mass of a normal hydrogen atom, and oxygen-18, an atom that weighs about 10 percent more than a normal oxygen atom. Steve, who earned his PhD in geology from the California Institute of Technology, says that on average, one in 500 oxygen atoms will be O-18, and one in 2,500 hydrogen atoms will be deuterium. All comparisons are made with seawater, known as V-SMOW, for Vienna Standard Mean Ocean Water, as set by the headquarters of the International Atomic Energy Agency in Vienna.

However, the ratio of these isotopes in rainwater varies depending on season, elevation, and latitude, due to a phenomenon known as the "rainout effect." As a storm mass travels over land and precipitates, the heavier molecules are the first to fall. Thus, as the storm mass progresses, rainwater becomes progressively lighter.

In New Mexico, air masses normally originate over the Pacific Ocean in the winter and the Gulf of Mexico in the summer. Air masses from the Pacific travel farther, losing more rainwater as they pass over successive mountain ranges and stretches of desert terrain. Air masses from the Gulf, on the other hand, don't travel as far or precipitate as much, and the rainwater they generate in New Mexico contains more heavy isotopes.

Seasonal recharge of groundwater is an important environmental factor in semiarid regions such (Continued on Page Four)



# LAB NEWS

VOL. 44, NO. 3 SANDIA NATIONAL LABORATORIES FEBRUARY 7, 1992

### Lots of Deliberation to Go, But . . .

## FY93 Budget Looks Good So Far

Sandians can be cautiously optimistic about the Labs' FY93 budget, says VP Paul Stanford, Sandia's Chief Financial Officer. No firm conclusions can be drawn yet about funding for future individual activities, he says, but preliminary numbers indicate that the Labs' fiscal outlook is as good as Sandia expected.

On Jan. 29, one day after President Bush delivered his State of the Union Address, Secretary of Energy James Watkins announced DOE's FY93 budget request. The proposal includes cuts in weapon production spending but no substantial cuts in research spending. Watkins also announced that he does not favor consolidating any of the national laboratories in the near term; however, the labs are finding ways to consolidate functions to reduce costs. He also believes there will be no US ban on underground nuclear testing.

Although the Labs' budget is not growing, says Paul, the bottom line looks pretty good. He cautions that there are still significant hurdles to overcome, however. "Basically, we don't foresee any big changes," he says. "Although we won't have a clear picture of next year's activities until Congress approves a budget, we're proceeding with our current plans for FY93."

This plan includes stepping up technology transfer and industrial partnering efforts as well as forging ahead on waste management and environmental restoration activities. "The world is changing," says Paul, "and the work we do is going to be different. We've really got to demonstrate that research and development adds value to the country."

Watch for updates on the FY93 budget in future issues of the LAB NEWS.

### Gearing Up for More Cooperation

## Automakers and Labs May Get into R&D 'Fast Lane'

• A General Motors engineer in the "crash business" looks at an information sheet describing Sandia's massively parallel computing capabilities. Instead of crashing cars, he wants to crash computer models of cars. That requires solving

"The challenge is to ensure our national prosperity."

extremely complicated equations, and supercomputing could help him give better information to designers sooner — before designs go into production.

• A veteran factory worker, dressed in a blue work shirt with a United Auto Workers patch sewn on the pocket, picks up a Sandia casting. Such a part can be brought from design to reality with Sandia's FASTCAST program in as little as two (Continued on Page Five)

**Special Section:  
Labs Accomplishments  
for Fiscal 1991**



# This & That

**Save This One** - In most issues, we encourage folks to recycle the LAB NEWS along with regular white office paper, but we hope you'll save the middle 12 pages of this issue because they constitute our annual Labs Accomplishments section. It includes Sandia's top 124 technical and administrative accomplishments (selected by Labs VPs) and is as close as Sandia comes to publishing an annual report. It's handy to have around when you want to give customers, visitors, and even relatives an overview of our work. LAB NEWS writer Linda Doran coordinated the Labs Accomplishments section. Thanks go to Linda and to the many folks throughout the Labs who submitted items and reviewed them.

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**Will I Ever Learn?** - Probably not, but it seems inevitable that every time I point out errors in other publications, we make one of our own. In the last issue, I noted some gaffes made by writers and editors elsewhere, and in the same issue we used the word "site" for "cite." But, hay, at leased we spelled it write, sew their!

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**Better Communication Today?** - Employee surveys in large organizations usually indicate that employees want more frequent and better communication with management. Although I sometimes think management bashing has replaced baseball as the real national pastime, I also think it's appropriate to recognize the positive things that management does. And I believe that employees appreciate the efforts that many Sandia managers have made in the past few years to keep us better informed.

Labs President Al Narath is a modest fellow, and he'll probably shoot me on sight (notice that I didn't say "on cite" or "on site") after he reads this, but I think he deserves considerable credit for his efforts to communicate directly with employees. Al regularly holds quarterly all-employee briefings with question-and-answer sessions and keeps the groups small enough to encourage two-way communication (seven briefings were scheduled this week). Other Sandia managers are helping to improve communication through the "Management Town Meetings" and "Brown Bagging with Brass" programs, and more Sandia managers now seem to be holding regular employee briefings. All of this is not to say that we've perfected management/employee communications at Sandia just yet - particularly when it comes to the need for concise written communications. I swear there are days that I hear my in-box groaning from the weight of the incoming memos and newsletters.

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**One Way You Can Help** - Here's a way that you can be better informed and simultaneously reduce the amount of paper that you get: Read the Sandia Weekly Bulletin and LAB NEWS thoroughly. It's obvious that you'd be better informed, but you may wonder about the paper-reduction part. More than a few times, I've heard Sandians say they put a notice in the Bulletin or LAB NEWS, but that many employees claimed they didn't see it. Guess what these Sandians do the next time they have an announcement they want all employees to see? You got it. They print a separate notice and send it to all employees, using 8,000 or more sheets of paper, adding to the internal mail distribution load in the process. We'll discuss other ways to improve communication in future issues. Drop me a note at Division 3162 if you have related ideas, especially if your group's doing something that's working well. ●LP

## Here's How to Get Yours

# Labs Information Booklet Available

The 1992 Sandia general information booklet is hot off the press, and you can get one. The 24-page illustrated guide to Sandia programs, facilities, and statistics is available to Sandians for their information and for communicating with visitors, vendors, customers, and others about the Labs' roles.

Copies have been sent to all Sandia supervisors. Other Sandians can get a copy by sending a self-addressed internal mailing envelope (9-3/4 by 12 inch) to Division 3161. Sandians who need multiple copies can contact Iris Aboytes (3160) on 844-8066.

## feed nback

**Q.** Why are we spending money on a company calendar ["Spirit of Sandia" calendar issued by Quality Org. 4300]? And, if we're going to do one, why can't it be on less expensive, recycled paper?

**A.** Several employees have asked why we are doing this calendar and have made suggestions for improvements. We appreciate your interest and your suggestions.

The calendar has a dual purpose: (1) To provide a quick reference about what's happening at the Labs - a list of events that employees may want to attend and participate in. Employees say again and again that they want better communication at the Labs, and the new calendar pages that will be sent to each employee once a month are intended to help in this area - to keep all of us better informed about what's happening. (2) To convey information about our quality initiative and other initiatives that are being integrated under the "quality umbrella" in Org. 4300. By combining information about these initiatives with the calendar, we hope to reduce the pieces of paper in employee mail slots and convey relevant information about the initiatives in a more efficient way.

We estimate that the printing costs for the calendar will be about \$1.80 per employee for the year. We believe this investment in communication will be worth the costs. Your suggestion to use recycled paper is a good one, and future monthly updates will be printed on recycled paper. We welcome all suggestions about how we can make the calendar better and more useful for you and how we can better communicate information about our initiatives.

Charles Tapp (4300)

## Take Note

The Central New Mexico Section of the Society of Women Engineers (SWE) hosted the Society's Quarterly National Board of Directors Meeting Jan. 30 through Feb. 2 in Albuquerque. Jan Williams (6600) and Margie Whipple (6224) chaired the industry roundtable. Participants discussed issues of concern to women engineers such as family issues, upward mobility, and the effect of changes in the defense budget on the employment picture for engineers in New Mexico. Al Narath was one of several community leaders who spoke. SWE is a non-profit educational organization whose objectives include informing young women about engineering opportunities and encouraging women engineers to attain high levels of educational and professional achievement.

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New Mexico Governor Bruce King and his wife Alice will host the Sixth Annual Valentine Charity Ball Saturday, Feb. 15, from 6 p.m. to midnight at the Albuquerque Convention Center. Tickets are \$75; proceeds will benefit high-risk youth at New Day Shelters. Cadillac Bob and the Rhinestones will perform. For more information and to order tickets, call 888-1416.

Jim Jacobs (7800)



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**Can Replace Intrusive Techniques****Ionization Probe in Head Gasket Offers Engine Designers a Better View of Combustion**

As a complement to his fiber-optic spark plug probe that received wide attention about two years ago, Pete Witze, of Combustion Applications Div. 8362, has developed another non-intrusive diagnostic tool — a gasket containing ionization probes — that promises to help US engine designers. A prototype has already been tested by General Motors and is soon to be produced commercially.

The spark plug probe detects combustion optically, during the first milliseconds of flame formation. In the new device, multiple ionization probes

**Eight equally spaced probes show when and how uniformly the flame fills the cylinder.**

in the cylinder head gasket detect the flame near the end of combustion, when it reaches the perimeter of the cylinder.

In the GM tests, the probes were used to investigate performance differences between engine cylinders during the same combustion cycle and in the same cylinder from cycle to cycle.

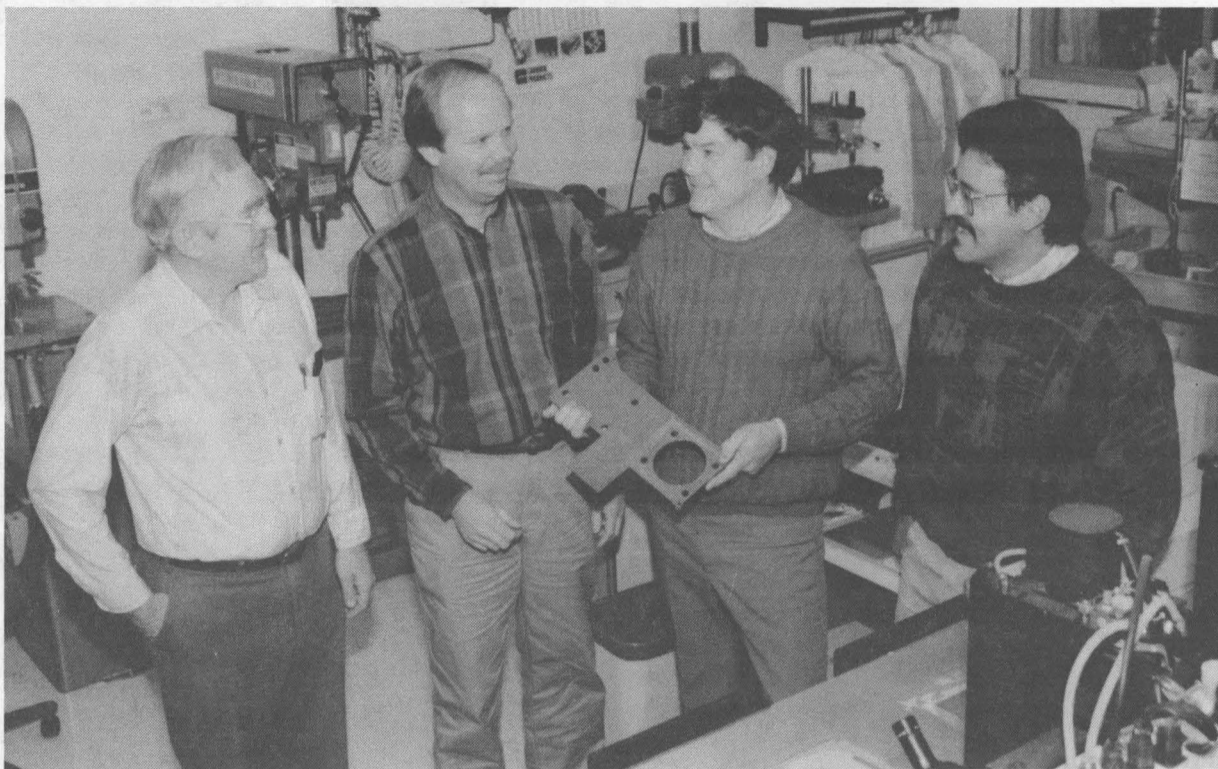
Pete explains that combustion begins in the spark gap, usually near the cylinder axis, and evolves as a burning flame surface that propagates radially outward. The high temperature in the flame front produces ions that distinctly mark the position of the flame as combustion progresses.

The ionization probes in the gasket are exposed electrical conductors at the gasket interface with the cylinder bore. A voltage applied to the conductors attracts the free electrons in the flame, producing a distinct signal the instant the flame contacts the probes. Usually, eight equally spaced probes are used, giving a measure of when and how uniformly the flame fills the cylinder.

**Gasket Becomes Circuit Board**

Although ionization probes have been used routinely in engine research for some time, they required machining modifications to the engine block or head. Instrumenting the gasket is a new approach that allows easier application to production engines. The unique twist to Pete's design is that the gaskets are printed circuit boards made with a high-temperature material. Pete worked with Vern Barr of Electronics Prototype Laboratory Sec. 8453-1 to develop this technology. The gaskets were fabricated in the Electronics Prototype Lab.

It was nearly two years ago that Pete first told the US auto industry of his success in using the gasket in a low-compression research engine. "The industry folks were very interested in the simplicity and potential value of the technique," he recalls, "but were skeptical that a printed circuit board could survive the harsh environment of a production engine. With the encouragement of



CHECKING HEAD GASKET containing the printed circuitry produced in the Electronics Prototype Lab are (from left) Vern Barr (8453), Duane Sunnarborg, Pete Witze, and Rodney Sepulveda (all 8362).

**SANDIA LIVERMORE NEWS**

Mike Dyer [8300A], we decided to take the technology transfer process one step further and demonstrate the concept in a production engine."

Pete's work soon aroused the interest of Dan Nicholson, head of a combustion analysis group at the GM V-6 Powertrain Division in Flint, Mich.

**"Industry folks were very interested . . . but were skeptical that a printed circuit board could survive the harsh environment."**

With the help of Duane Sunnarborg and Rodney Sepulveda (both 8362), and funding from the Advanced Industrial Concepts Division of DOE, a complete system including the gasket, electronics, and data acquisition and processing software was loaned to GM. In addition, Pete and Rodney spent the first week of the five-week test period on site at GM, showing researchers there how to use the equipment.

**Reduces Complexity and Expense**

Because the device is intended to help during engine design, not production, it is not needed in large numbers. DSP Technology in Fremont, Calif., a major manufacturer of pressure instrumentation, is now working with Pete to transfer the technology and produce additional printed circuit board gaskets for two upcoming GM projects. Southwest Research Institute (SRI) in San Antonio, Tex., also plans to make gaskets and ionization probe electronics. The company earlier sent representatives who spent a week at Sandia learning to operate the probes. Sandia has loaned SRI both the spark plug and gasket probe systems.

In a letter to Sandia President Al Narath, the Director of Engine Engineering for GM, Thomas Stephens, said, "The probe has been used extensively on GM's 3800 (3.8 liter) engine to investi-

gate cylinder-to-cylinder and cycle-to-cycle differences in combustion performance. It has proved to be a valuable tool for engine development, as it provides information on flame geometry without the added complexity and expense of alternative flame visualization techniques. We plan to use the probe on a number of upcoming engine development programs."

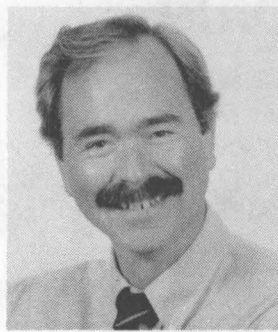
In his letter, Stephens summed up: "I truly appreciate the support that Sandia has provided General Motors in applying this new technology to our engine development process. It is my sincere hope that our organizations can continue to work together in the future to develop the tools necessary for designing more efficient combustion systems in our engines." ●BLS

**Take Note**

Sandra Bowers (8484) has been named to the board of directors of the Tri-Valley Haven for Women in Livermore.

**Congratulations**

To Kelly (8531) and Bob (5376) Oetken, a son, Derek James, Jan. 24.

**Employee Death**

JOHN KRAABEL

John Kraabel, Acting Supervisor of Advanced Electronics Div. 8432, died Jan. 20 after a short illness. He was 45 years old.

John had been at Sandia, Livermore for 13 years. He was a Distinguished Member of Technical Staff.

He is survived by his wife, Rosemary Chang, a former Sandian.



John Leeper  
8432

**Recent Retiree**



*(Continued from Page One)*

## Carlsbad Caverns

as the Chihuahuan Desert, which extends southward into Mexico from western Texas and southeastern New Mexico, and other parts of the American Southwest, where groundwater resources are increasingly taxed as more and more people relocate to the Sun Belt. It is conceivable, notes Steve, that residents in some areas may be tapping fossil groundwater, which is an unrenewable supply.

Fossil groundwater is very old, and is believed to have been recharged during the last Ice Age, which ended 10,000 to 11,000 years ago. Ice-age glaciers are known to have extended as far south as the Sierra Blanca Mountains between Cloudcroft and Ruidoso, but elsewhere in New Mexico, the effect of the Ice Ages was to produce more pluvial conditions — rainfall and snowfall. Many bodies of groundwater in the region may have been recharged then, says Steve.

Scientists know that fossil groundwater is older by measuring the radiocarbon decay of dissolved carbon dioxide in the water and by examining the isotope ratios. Fossil groundwater in the Carlsbad region contains less deuterium and O-18 than other groundwater, notes Steve, perhaps because the climate was different in the past and air masses traveled in different patterns. Using carbon-dating, Steve has estimated groundwater above the Waste Isolation Pilot Plant near Carlsbad to be about 12,000 years old. Although its saline content is too high for most uses, a specially adapted breed of brahma cattle in the region can drink the water and survive, unlike cattle from other parts of the country.

### Groundwater in the Southwest

Visitors to Carlsbad Caverns may occasionally notice Steve installing equipment off the trail, such as near the entrance to the famous Bat Cave. For the most part, however, he will be invisible. In some locations, such as the scenic rooms (the Green Lake Room, King's Palace, Queen's Chamber, and Papoose Room), he will set up his equipment after visitors have left for the day or in the morning before they return.

At a couple of steady dripwater sites where there is no place to mount a ring stand, Steve holds a funnel at the end of a stick for a few minutes to collect a sample. A steady stream of water is needed, because water that takes a long time to percolate has more chances to evaporate, and evaporation changes the isotopic composition.

He is collecting samples at four different depths of up to 825 feet. Besides the scenic rooms and a site near the Bat Cave, he also has stations in



AT SOME DRIP SITES where it is not possible to set up a stand, such as this one on the side of a stalagmite near the Hall of Giants, Steve Lambert (6233) collects water samples by attaching a funnel and cylinder to a long wooden pole.

the Big Room and in Lower Cave, an area that is not normally accessible to visitors.

By comparing the dripwater he collects in the caverns with rainwater collected at the surface, Steve hopes to determine not only the drip rate at various times of year, but also how much water actually makes it to cavern depths. Perhaps some of it evaporates; perhaps only water from heavy rainstorms sinks to greater depths; or perhaps it has to rain for a certain length of time before enough water accumulates to percolate through the unsatu-

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**"I'll be monitoring rainwater at the surface to match its composition with the water that percolates below."**

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rated zone — the part of the earth's surface that is dry except when it transports water.

"During the experiment, I'll be continually monitoring rainwater at the surface to match its composition with the water that percolates below," says Steve. "I have a co-worker in the Carlsbad Caverns area who has agreed to collect rainwater samples for me and transfer them to the capped bottles." The co-worker is Dale Pate, a cave specialist for Carlsbad Caverns National Park.

The National Park Service is also interested in

the results, adds Steve, because construction of the parking lot above the caverns has covered an area where water used to percolate into the cave. Park rangers would like to know if this has significantly affected water recharge in the cave; if so, they may decide to install drains or another means of replenishing it.

A similar problem occurred at the caverns in the 1970s, when the US Geological Survey analyzed falling water levels in Mirror Lake and other natural pools in the cave. They discovered that the elevator shaft built to accommodate visitors was conducting moisture back out of the cave. The park sealed the waiting area outside the elevator shaft with glass windows and revolving doors, and the water levels were restored.

"The park is very interested in having scientific research done here, in learning more about our park so that we can manage our resources better," says Dale.

### Back at Sandia

The dripwater samples will be analyzed at Sandia using a precise mass spectrometer. To measure deuterium, each sample will be put into a hot uranium furnace that takes the oxygen out and lets the hydrogen through without changing the isotopic composition. The end products are hydrogen and uranium oxide.

To measure O-18, the water samples will be frozen with dry ice, the air pumped out, carbon dioxide added, and the sample sealed off, allowed to melt, and kept at room temperature (77 degrees F) for a week to allow the carbon dioxide to react with the water. This will allow the carbon dioxide to take on a natural isotopic composition that is proportionate to the O-18 in the water. At room temperature, carbon dioxide will always have 4 percent more O-18 than does water, says Steve. ●LD

## Cavern Research Attracts Attention of National Park Visitors

"Did you catch anything?"

"What are you doing, swimming?"

"He can seine for minnows anywhere he wants."

These are just a few of the occasional quips from visitors who happen to pass Steve Lambert (6233) while he is at work collecting dripwater samples in Carlsbad Caverns. Of course, there are no minnows — in fact, there are no fish — but seeing a person holding a stick out over a pool of water, even if it is attached to a funnel and a cylinder, seems to remind people of fishing.

"How thick is the rock above you?" inquires a visitor from Wisconsin. "Right here, it's 720 feet," answers Steve, as he measures a water sample from Mirror Lake, a large reflective pool in the Big Room, the largest known underground room in the United States.

Explaining things to visitors is all in a day's work in the cave. One of the most frequently asked questions is whether the water is drinkable. "Well, it's probably not as good as the water you get out of the drinking fountain," says Steve, adding that it has a very high mineral content.

"Are they biting?" asks a man from Minnesota who passes a drip site near the Rock of Ages, also in the Big Room. "Yes, they are," says Steve. Soon, he explains to the man and his wife that he will be collecting drip samples once a month and taking them back to the laboratory for analysis. He says he hopes to determine how water gets into the cave, how long it takes, and if it varies with the seasons.

"So if you come back at about the same time next month, you'll probably still find me here," he adds.

## Welcome

*Albuquerque* — Trudy Blake (21-1), William Boling (3435), Michael Craig (3435), Alfred Garcia (3435), Lawrence Jackson (3435), Warren Lewis (7715), Walter Lucero (3435), Larry Luna (7842), Miriam Minton (3435), Mary Padilla-Myers (3141), David Seabrook (3435), Daniel Stump (3435), Charles Thomas (7820). *Other New Mexico* — Mark Davis (3435), Harry Gabaldon (3426).

Elsewhere: *Colorado* — Raymond Garcia (3435); *Florida* — Kerry Sturgis (7712).



# Labs Accomplishments FY91

Continuing a LAB NEWS feature begun 11 years ago, Laboratories Accomplishments FY91 sums up the principal achievements of Sandia National Laboratories during the fiscal year that ended Sept. 30.

The work summarized here has been submitted by organizations in Albuquerque, Livermore, and Tonopah. Items have not been ranked in any way, but an attempt has been made to group related items. The directorates that accomplished each achievement are shown in parentheses after each item.

Requests for further information should be sent to Public Information Division 3161, Sandia National Laboratories, Albuquerque, NM 87185-5800.

## To All Sandians:

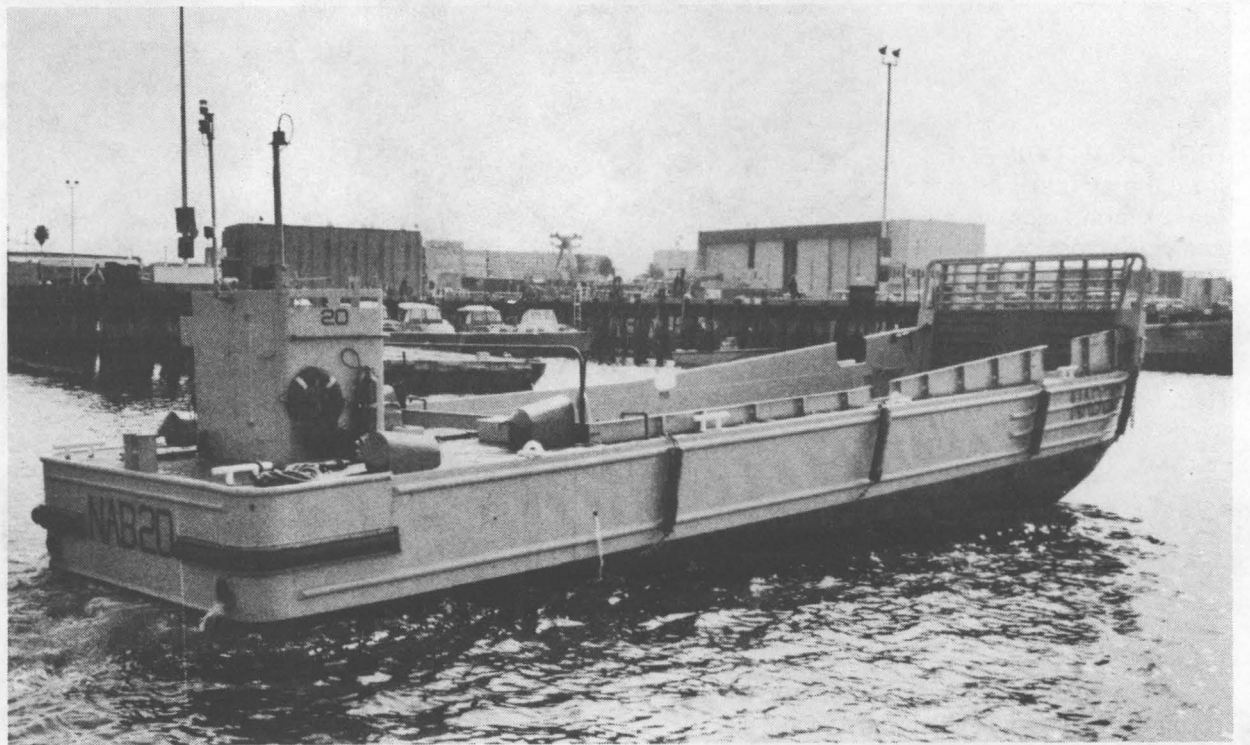
The pace and intensity at which our world has changed in the past few years is nothing short of astounding. And much change continues today — change in the world's political, economic, and military systems that will likely reshape Sandia's future.

With so much change happening so quickly, it can be difficult to focus and concentrate on our traditional fundamental tasks, but reviewing this collection of FY91 accomplishments made me realize again how well Sandians remain focused on their work — analyzing and solving significant problems even during trying times.

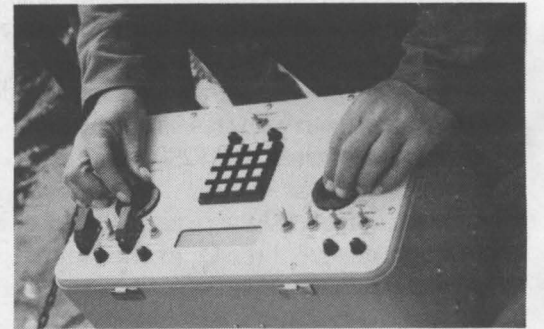
As I reviewed these examples of the Laboratories' FY91 achievements, I was particularly impressed by two "themes" — our versatility and our adaptability. Our range of scientific and engineering skills and facilities gives us unique capabilities that are being used to serve the national interest in traditional energy- and defense-related roles and in emerging areas such as environmental cleanup, robotics, environmentally conscious manufacturing, and cooperative work with industry to improve US economic competitiveness.

In short, I'm proud of our FY91 accomplishments, and I hope all Sandians are equally proud. Congratulations to everyone who contributed.

Al Narath  
President



SANDIA'S MANY behind-the-scenes contributions to Operation Desert Storm included development of remote-control landing equipment to assist in mine-clearing and beach assault operations. Though not actually used during the Persian Gulf conflict because no beach landing was necessary, the technology was successfully demonstrated on a Navy LCM(6) vessel in San Diego Bay (pictured) and on a Navy LCM(8) vessel. An operator on another boat remotely controls the vessel.



## LAB NEWS

SANDIA NATIONAL LABORATORIES SPECIAL SECTION

FEBRUARY 7, 1992

### Defense-Related Work

During the first few months of 1991, Sandia contributed to several initiatives in support of **Operation Desert Storm**. Sandia developed, demonstrated, and delivered remote-control equipment for landing craft in beach operations after testing it in San Diego Bay. The systems are now being considered for future mine-clearing operations. Sandia developed and demonstrated a large fuel-air munition for the Marine Corps that was intended to help breach the barrier network on the Kuwait-Saudi border. In a one-week period, Sandia designed, fabricated, and tested a system to help identify friendly vehicles from the air. Sandia also studied improved fuzing systems for conventional bombs in conjunction with industry. (9100/9500)

Sandia completed its investigation of the 1989 explosion aboard the USS Iowa that killed 47 crewmen. Sandia submitted a report to the General Accounting Office. Researchers found no explicit evidence that the explosion was caused by an ignitor purposefully planted by a crewman, a theory originally proposed by the Navy. In addition, Sandia researchers showed that overramming of the bag charges was a possible cause of the explosion. (300)

New technology developed at Sandia will help foot soldiers **neutralize anti-personnel mines**. The project is part of the soldier enhancement program administered by the Army at Fort Belvoir in Virginia. The project has three components: chemical neutralization systems, foam neutralization systems, and a portable mini-line charge explosive system to clear a foot path through surface mines. The explosive system uses a small rocket to propel a 165-foot-long line charge into a mine field. When detonated, the charge clears a path through the mine field. (9500/2500/1800/9300/2700)

Sandia successfully completed a demonstration and analysis of **Low Observables (LO) Technology** (methods for making things less susceptible to being detected) for the US Army. The program focused on demonstrating the application of LO technology to Army systems and evaluating its effectiveness. As prime contractor, Sandia directed a large group of private contractors and Army test organizations in designing and fabricating test hardware and collecting, evaluating, and analyzing the necessary data. The results have wide-ranging implications for current and future Army systems. (9100)



## Defense-Related Work

HIGH-QUALITY IMAGES from the air, such as this one of farm fields, trees, and pipes crossing the Rio Grande near Belen, N.M., can be taken through cloud cover or any kind of weather using Synthetic Aperture Radar.



A new, high-performance **automatic target recognition system** developed by Sandia can identify targets in high-resolution sensor images. To achieve this, Sandia developed sophisticated signature-matching algorithms and high-throughput image-processing hardware modules, and combined them with standard industrial electronic equipment. (9100/2300)

Sandia completed the overall electrical and mechanical design of the **Operations and Deployment Experiments Simulator (ODES)**, a post-boost vehicle that will enable the Strategic Defense Initiative Organization and other defense organizations to perform payload deployment experiments in space. The Sandia-developed propulsion system integrates recycled Apollo engines with custom-designed fuel delivery components. Sandia fabricated and tested a prototype of the composite structure, and at NASA's White Sands Test Facility, Sandia and NASA researchers worked together to fire the rocket engines and test their performance. A Sandia-designed thrust vector control subsystem actively positions the rocket engines to provide attitude control. ODES is funded by the Army Strategic Defense Command. (8400/8200)

Major improvements in **Synthetic Aperture Radar (SAR)** technology have enabled production of high-quality images from the air. An airborne SAR makes images by bouncing radar signals off terrain while traveling along a flight path and then processing the radar echoes. Radar has the advantage of being effective in all kinds of weather, day or night. Sandia has advanced the technology through new image-formation algorithms, high-speed digital-signal processing, miniature microwave hybrids, precision motion compensation, and high-accuracy navigation. (2300/9100)

Sandia conducted various **flight tests of reentry vehicles (RVs)** for the Air Force, Army, and Strategic Defense Initiative Office. In one test, Sandia developed and launched an RV to test the effects of a small-burning rocket motor on the optical and radar signatures of the RV, effects that make RV identification difficult. The test also measured atmospheric properties and heating effects at extremely high altitudes. Another test involved a small vehicle containing a rocket motor and a second vehicle containing instruments to characterize the environment around the RV. Sandia completed two intercontinental ballistic missile (ICBM) tests

designed to demonstrate that an interceptor can track, designate, and destroy a test object on an ICBM trajectory. In yet another test, a fully instrumented RV and 16 decoys were launched on an ICBM flight to obtain optical and signature data that will help identify real vs. decoy targets. (9100/5100/1500/2300/2700)

Sandia developed new techniques to evaluate **advanced torpedoes**. One such technique, developed with the Naval Underwater Systems Center, uses finite element methods to predict failure and fracture propagation in ductile metals. A Sandia-developed material model accurately accounts for plasticity and void growth in metals. Numerical analyses determine the effects of blasts on steel plates. Variables in the study included different blast levels, types of steel, and the presence or absence of a hole. Plates were subjected to explosively generated blasts to validate numerical predictions. Results showed excellent agreement between numerical analysis of the extent of damage and that observed during actual experimentation. (8200)

In three Strategic Defense Initiative flight tests, Sandia's **Mini-RIMS Inertial Measurement Systems** and **SANDAC V** computers performed flawlessly, providing navigation, guidance, and control. Tests included two target vehicle flights and a Strypi rocket flyby experiment with the Low-Power Atmospheric Compensation Experiment (LACE) satellite. To reduce the size and weight of the control systems, Sandia developed a single-board replacement for SANDAC that fits in the Mini-RIMS package. This upgrade, called RIMDAC, weighs only 12 pounds. Sandia also completed development of a highly accurate, ring-laser gyro inertial measurement system in cooperation with the Air Force and Honeywell Inc. Called RLGA, the system will be used in several Sandia and Air Force projects. The guidance system Sandia developed for STARS (Strategic Target System) has attracted interest from four US aerospace companies. The RLGA, SANDAC, and a gimbal system all performed well in experiments on a DOE Twin Otter aircraft. (2300/9100)

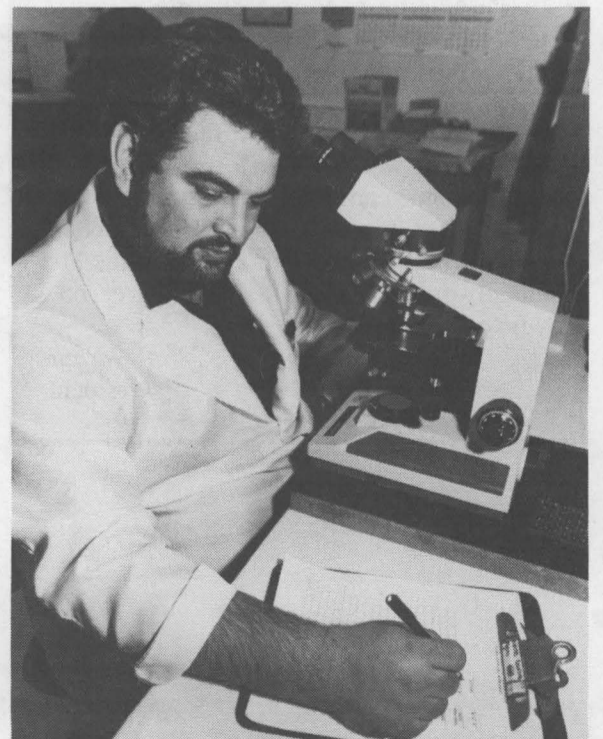
## Environment, Safety, & Health

The **DOE Tiger Team** visited Sandia, Albuquerque in April and May of 1991. The "Tigers" reviewed Sandia's ES&H (Environment, Safety & Health) procedures and activities for compliance with various DOE and OSHA (Occupational Safety and Health Administration) regulations and orders. In its final report, the Tiger Team found that "while significant ES&H issues still exist at Sandia, Albuquerque, and their resolution will take a concerted effort by all levels of Sandians in the future, the seeds of excellence have been sown and their cultivation has begun. If Sandia, Albuquerque, carries through with these ES&H initiatives, it has the potential to become the model DOE Laboratory, one that the Secretary of Energy will direct other DOE facilities to study in the search for excellence." (7000)

The **ES&H Audit Management Project Team** was organized in January 1991 to identify all technical and logistical requirements prior to the Tiger Team visit to Albuquerque in April and

May. The team was also responsible for supporting the Tiger Team during its visit. The scope of activities include pre-assessment planning, computer support, establishing a comprehensive ES&H library and document control system, providing a public and media relations interface, establishing logistical support, addressing access requirements and other security-related issues, identifying Sandia employees to act as counterparts and training them to work with the Tiger Team, and establishing a mechanism for processing the Tiger Team's findings. The team supported the Tiger Team in an efficient and coordinated manner, enhancing the quality of the review and its benefit to the Labs. (7000/3700)

Sandia developed the **Facilities Asbestos Management Program** and its associated Manual of Practice in response to concerns about employee health, environmental quality, and statute requirements. The program received high marks during the Tiger Team audit. (7800)



**ASBESTOS ANALYST** Dominic Zarrella (contractor) examines asbestos air samples under a microscope to determine if asbestos levels meet OSHA limits.



# Environment, Safety, & Health

The ES&H Project Management Office organized the **Sandia Final Action Plan** in response to DOE's Tiger Team assessment of Sandia, Albuquerque. This endeavor covered a seven-month span and required the coordinated efforts of approximately 250 Sandians, including ES&H professionals, line organization employees, various support groups, and Sandia managers. The resulting plan, which will be submitted to Energy Secretary James Watkins early this year for his approval, will form the foundation for ES&H planned activities for the next several years. (7020)

Two US Navy geophysical tools originally developed to locate and identify unexploded ordnance underground are being used to **identify and characterize buried materials** in Sandia landfills. The tools are part of two larger arrays of instruments that are towed across the ground and are known as STOLS (Surface Towed Ordnance Locator System) and RADAR (Ground Penetrating Radar Ordnance Search System). The systems were developed by the US Naval Research Laboratory and the Navy Explosive Ordnance Disposal (EOD) Technology Center with support from Geo-Centers Inc. In a team effort with Sandia, these tools were successfully tested at selected Sandia Environmental Restoration sites. In all the areas evaluated, the systems located many subsurface items. (7700)

Hazardous Waste Management Facility employees developed a unique, **bar-code-based chemical waste tracking system**. The serialized bar code system allows employees to track chemical waste from the request for disposal to the final disposal location, and all steps in between. The data management system supports not only Sandia's waste minimization program, but the requirements of the Resource Conservation and Recovery Act, which calls for "cradle-to-grave" management of hazardous waste. The system includes a customized set of cross-reference tables to ensure proper storage, packaging, and disposal of chemical waste. It also collects and stores extensive information on waste generators, waste streams, waste profiles, and the total quantity of waste generated. (7700)

Sandia's **Construction ES&H Program** got under way with the development of a Standard Operating Procedure produced by the Construction Management organizations. This document has been presented at several DOE-wide conferences and is finding application throughout the DOE complex as a baseline for construction program development. Sandia's SOP provides for implementation of DOE orders 5480.9 and 6430.1A. (7800)

To aid Sandia's Environmental Monitoring Program, Sandia developed the **Continuous Monitoring pH Log-In System (CMPLIS)**, a radio-frequency polling system that interrogates wastewater monitoring stations to provide real-time information on flow, pH (acidity vs. alkalinity), equipment failure or power loss, and pH violations. Whenever the system encounters an alarm condition, it automatically attempts to notify an operator using pre-programmed telephone numbers. CMPLIS is programmed to interact with monitoring stations to obtain samples in the event of pH violations; the operator may also issue instructions to get samples on demand. Monitored data is collected automatically and stored in historical data bases that may be used for trend analysis and report generation. The system can be expanded as Sandia expands its wastewater monitoring program to include monitoring of radionuclides. (7700)

DOE approved the **1990 Environmental Site Report** for Sandia, Livermore, documenting the results of the Environmental Monitoring Program and Sandia's compliance with environmental laws and regulations. The report concluded that operations posed no harm to the public or the environment, and that Sandia complied with all regulations governing emissions to the environment. (8500)

The Technical Library handled 1,900 information requests from 850 customers and produced more than 76,000 pages of photocopies during the Tiger Team visit to Sandia. This work was accomplished through a special **ES&H Library and Documents Center** set up during the six-week Tiger Team visit. Tigers were able to obtain copies of documents such as permit applications, programs, procedures, memorandums of understanding, and site maps. (3100)

A major accomplishment in 1991 was the development of the **Corporate Chemical Hygiene Plan (CCHP)** establishing work practices, protective measures, training, medical services, and Standard Operating Procedures for chemistry laboratories. All chemistry labs must implement this plan to comply with the OSHA regulation, "Occupational Exposures to Hazardous Chemicals," more commonly known as the Laboratory Standard. (Only chemistry labs are subject to the Laboratory Standard. All other work areas where chemicals are used must comply with the OSHA Hazard Communication Standard.) A CCHP pilot involving Sandia chemistry lab representatives and ES&H professionals was completed in March. The plan was distributed to all 292 identified chemistry labs in April and May. As a result of this cooperative effort, Sandia's chemistry labs are approaching full compliance with this regulation, and safety and health protection in these labs has never been better. In addition, the OSHA laboratory standard was fully implemented at Sandia, Livermore. (7700/8500)

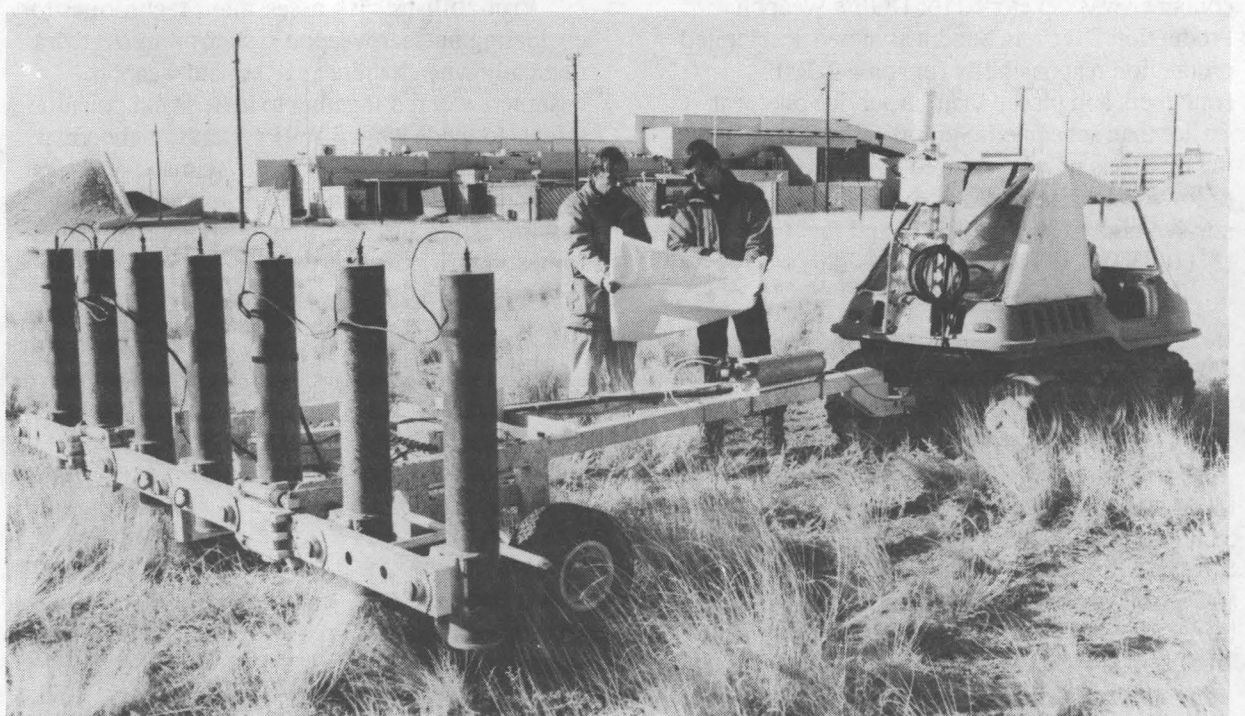
A new **tritium sampling system** for the Tritium Research Lab stack was developed and installed at Sandia, Livermore. The new system measures both tritium oxide and tritium gas in the stack effluent. (8500)



JOHN COCHRAN (7723) checks map of Area 2 landfill that received material between the 1950s and its closure in 1988. The site is one being assessed by Sandia to determine if it presents any threat to human health or the environment.

The **ES&H Document Control Center** oversees control, change, distribution, and notification of "Required Annual Review" of documents that support ES&H quality efforts. The system assures that documents and revisions are approved for release by authorized individuals and that the administrative controls are correct. These documents are permanently preserved in the film bank, printed, and distributed as indicated on the approved distribution list. (2800)

In May, DOE's Office of Environmental Restoration and Waste Management imposed a **moratorium on shipment of hazardous waste** originating in Radioactive Material Management Areas (RMMAs) for disposal to commercial facilities not licensed by the Nuclear Regulatory Commission. In order to have this moratorium lifted, DOE facilities had to submit procedures to DOE headquarters. A team of Sandians identified RMMAs at all Sandia sites and provided a package of procedures, plans, and programs that met DOE's July 31 deadline. In addition, team members completed an extensive records review, examining waste disposal requests dating back to 1980 to determine how much waste had been sent off-site for disposal that would have met current RMMA criteria. (7700)



ENVIRONMENTAL RESTORATION — John Cochran (right, 7723) and Jimmy McDonald of the Naval Research Laboratory consult a map in Tech Area 2 where Navy geophysical tools are being used to characterize buried materials in Sandia landfills. In the foreground is the Ground Penetrating Radar Ordnance Search System, an array of instruments that sends radar signals into the ground. (Photo by Mark Poulsen, 3162)



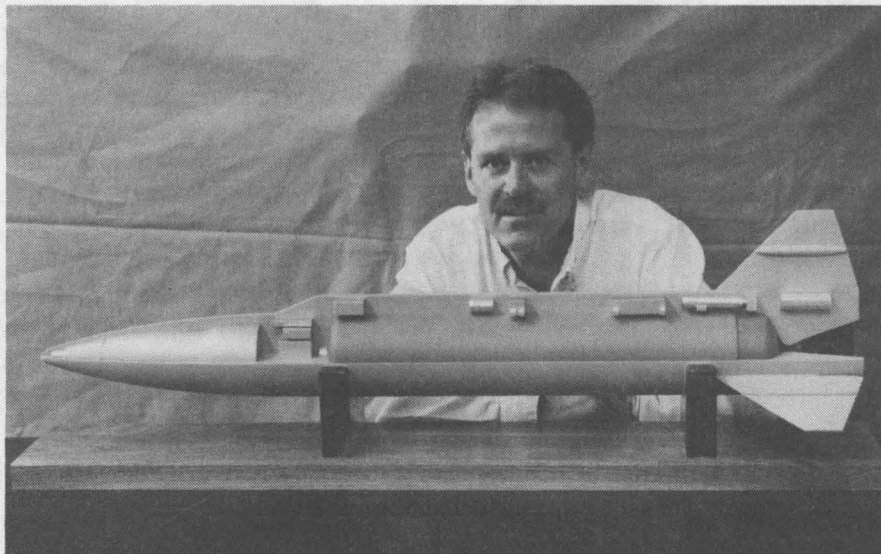
# Nuclear Weapons

Working with Pantex and the Navy, Sandia is prototyping National Security Agency **tamper-evident seals** as one means of assuring that denuclearized flight test units have not been opened, modified, or switched with an actual nuclear weapon. The seals are applied to strategic locations on the test units, and only by disturbing or destroying these seals could an adversary open or intentionally alter a unit. Throughout FY92, the tamper-evident seals will be evaluated on DOE/Navy flight test units. Upon receipt of a test unit, the Navy will inspect the seal for damage; any irregularities will be grounds for test cancellation and investigation. The tamper-evident seals are part of Sandia's Non-nuclear Assurance Program, which provides three independent methods of assuring that flight test warheads and bombs have not been inadvertently switched with actual nuclear weapons or intentionally altered to cause a nuclear incident. (300)

A newly issued **Weapon Waste Minimization Plan** outlines steps being taken by Sandia to reduce the use of hazardous materials and waste during the development, production, stockpile, and retirement phases of war reserve nuclear weapons (weapons currently in stockpile) and test units. An additional policy statement describes Sandia's commitment to these goals. Sandia is now teaming with all DOE production agencies to identify, safely disassemble, and dispose of weapons undergoing retirement that contain hazardous materials. (5300/5100)

Sandia developed two protective **containers for nuclear weapon system components** — the H1501A Accident Resistant Container for the Army, and the H1616 tritium reservoir shipping container. The Army containers are designed to withstand impacts of more than 100 mph followed by exposure to a fuel fire for 90 minutes or longer, and will assist the Army in removing tactical nuclear weapons from NATO sites. When empty, the containers weigh more than a ton each. Advanced material models were used to predict potential failure of the Army container's stainless steel casing and the large deformation crushing of interior components. The analysis shows the new container can survive impacts at higher velocities than previous shipping containers. As a result, the potential for a radioactive material release has been reduced. The H1616 tritium reservoir container was developed for DOE's Weapon Production Division. Sandia assumed accelerated production responsibility for some 2,300 containers and placed them in service one year earlier than scheduled. Spinoff technology from the H1616 is now being used to develop a family of low-cost warhead protective containers that can survive high impact velocities and fuel fires. (5100/5300/5500/2400/3700/8200)

MIKE CLOUGH (2473) built this model of the Alternative Short Range Attack Missile (ASRAM) in Sandia's Pattern, Foundry, and Heat Treat Sec. 2473-5.

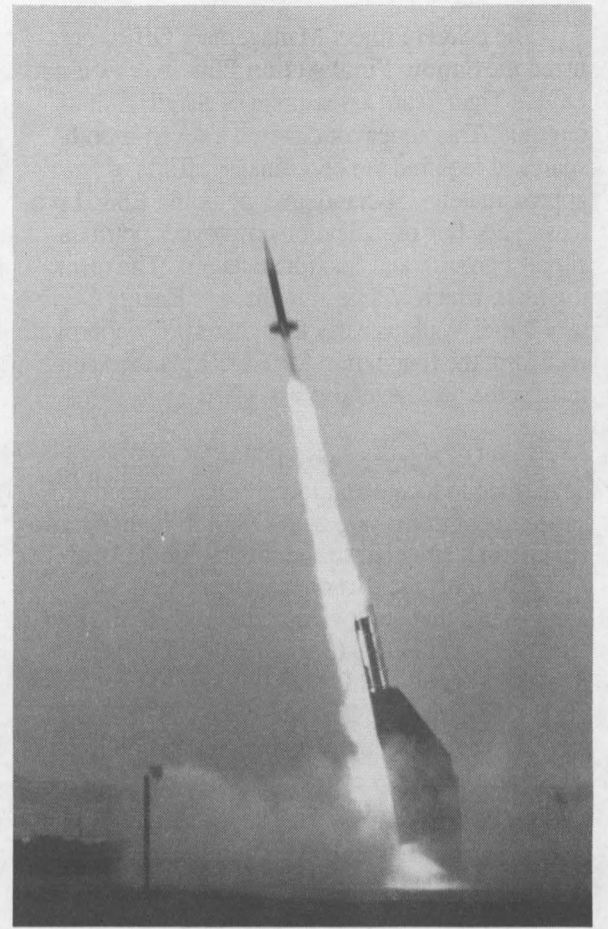


Sandia continued investigating high-speed water entry of potential **anti-submarine warfare (ASW) weapon body configurations**. A highly stable configuration developed by Sandia was launched from the Kauai Test Facility in February 1991. The unit hit the water at an entry angle of 29 degrees and a velocity of 987 feet per second. The purpose of the test was to record base pressure on the unit during impact, a measurement that is critical to the calibration of the hydrocodes being developed at Sandia to study stability, flow characterization, and water jet phenomena. The test unit was tracked by the hydrophone range at the Pacific Barstur Range. The unit, which came to rest beneath 2,526 feet of water, was retrieved five months later by the University of Hawaii's minisubmarine, Pisces II. (5100/5300)

Lower stockpile and weapon production requirements have prompted DOE to reduce costs by consolidating some activities in the production complex. As part of this effort, DOE asked Sandia to manage the procurement of some non-nuclear weapon components from the private sector. Through the **Manufacturing Development Engineering** program, Sandia procures products from private manufacturers who must meet the highest quality requirements set by DOE. Sandia's challenge will be to maintain an effective network of suppliers and still meet production schedules and quality requirements. (5400)

The **Joint DoD/DOE Transportation Study**, an evaluation of the security and plutonium dispersal risks associated with the transport of nuclear weapons, is now in the final publication phase. Sandia is a participant in the study, which was commissioned by the Nuclear Weapons Council in October 1989. The assessments of security risks and the probability of accidental plutonium dispersal provide decision makers with information useful in selecting nuclear weapon transportation modes and proposing measures to enhance protection. Study results are currently being used by the Army to evaluate the benefits of protective overpack containers for return of weapons from overseas. In the future, the study will be used by all the military services and DOE to support decisions pertaining to return of weapons and the safety and security of the nuclear weapon stockpile. (300/9500)

**Probabilistic risk assessment techniques** for evaluating nuclear weapon systems improved dramatically when Sandia analysts and weapon designers worked together to understand potential threats to the W89 and W91 systems in abnormal accident environments. Their systematic analyses provided a rational basis for setting priorities in system testing and determining appropriate ranges for testing parameters. (6400)



ROCKET LAUNCHES from Sandia's facility in Kauai helped investigate high-speed water entry of potential anti-submarine weapons.

Sandia has been designated the lead laboratory for collection of nuclear safety-related information for the **Nuclear Safety Information Center (NSIC)**, which includes a computerized data base and archival management system. NSIC contains information about nuclear safety, weapon systems analysis, history, and specialized nuclear safety training for the nuclear weapons community. NSIC also provides support for development and training activities of the nuclear weapon Accident Response Group, including a videographic record of nuclear accident exercises and course materials. The DOE Nuclear Safety Oral History Program is also filed in the NSIC, portraying on video the experiences of individuals who have responded to nuclear accidents. Videographic techniques are also used to record the nuclear safety corporate memory. (300)

Sandia continued development of a new **Permissive Action Link (PAL) code management system** for the Strategic Air Command (SAC). Known as the **SAC Secure Recode System**, the new use-control system provides advanced features, such as the ability to communicate information to a weapon's PAL system in a completely encrypted format, and the ability to recode, from a single connection point, multiple weapons loaded on a rotary launcher. (5100)

Together with Los Alamos National Lab, Boeing Missile and Space Division, McDonnell-Douglas Corp., and the Air Force, Sandia conducted joint **flight tests of the W91/SRAM T**. The purpose was to provide vibration data on a mockup warhead carried by an inert missile on an F15E fighter-bomber. The unit survived multiple aircraft maneuvers covering the range of actual flight environments anticipated for the W91 warhead. The design team obtained information on the structural behavior of each internal component and identified a potential design flaw that was corrected at much lower cost than if it had been discovered later. The tests also provided key information on integrating the warhead with the missile and the aircraft. (5100)



# Nuclear Weapons

Until now, military Unsatisfactory Reports (URs) — quality-control mechanisms for tracking stockpile problems involving DOE — have been submitted and answered manually, with data being replicated as it passes through the DOE/DoD communication chain. To streamline and improve the quality of this process, the Military Liaison Department developed the **Reporting, Evaluation, and Auditing System for Unsatisfactory Reports (REASURE)** software program. This year, Sandia began using the system, which allows customers to locate information using keyword searches, automatically generate response letters, create ad hoc reports, produce statistical reports, and store and display photographic information. The system electronically coordinates information from all the agencies involved using local area networks and telecommunication devices. (5500)

Sandia's weapon systems and non-destructive technology groups demonstrated that **computer-assisted tomography** (the same technique as a CAT-scan in medicine) can be used to check for flaws in printed circuit boards for arming, fuzing, and firing (AF&F) systems. The design of the AF&F systems does not allow reliable electronic tests to be conducted, leaving researchers two alternatives for checking a circuit — either machine away the metal housing, disassemble it, and conduct a visual inspection, or develop a non-destructive test technique. The team accomplished the latter, and transferred the technology to Allied-Signal, where AF&Fs are evaluated. The estimated cost savings is \$100,000 per AF&F. (5100/2700)

Sandia developed a design alternative to the Air Force's AGM-131A Short Range Attack Missile (SRAM). The design, called **Alternative SRAM** or ASRAM, includes a low-risk rocket motor, a state-of-the-art guidance and control computer, and the proposed application of a commercially produced, high-accuracy inertial navigation unit. Sandia's expertise permitted quick identification of system requirements, development of preliminary air-vehicle design and performance, and assessment of the system's effectiveness and survivability. (5100/2400)



SANDIA DESIGNED the MC 3810 Arming, Fuzing, and Firing (AF&F) Assembly for the Navy's D5 Trident II missile.

With the goal of providing qualified nuclear warhead systems within two years from the time of a request and making the nuclear weapon complex more efficient and environmentally aware, Sandia's weapons directorates began developing more formal procedures for selection, assessment, development, and maintenance of nuclear weapon systems. These activities are officially known as the **Focal Point Project and the Standardization Enabling Project (STEP)**. The intent is to provide a complete evaluation of future weapon system architectures, technologies, and components before committing to their full-scale development. (5300/5100)

Sandia completed a series of static ejection and vibration fly-around tests with the **W89/SRAM II/B-1B** warhead, missile, and aircraft system at Edwards Air Force Base in California. Though funding for the SRAM II missile was recently discontinued, Sandia demonstrated that the W89 warhead is compatible with the currently deployed SRAM A missile, which could improve overall system safety well into the next century. The W89 is also the first warhead to have a comprehensive Nuclear Safety Specification in place during development and is the first warhead to incorporate stringent new Pentagon controls on nuclear safety. Also in 1991, the W89 program published a comprehensive ES&H Program Plan defining methods for eliminating hazardous materials, such as ozone-depleting solvents, and eliminating or severely reducing others, such as adhesive curatives, cyanide plating baths, and volatile organic compounds. (5300)

Sandia designed and developed the **MC 3810 Arming, Fuzing, and Firing (AF&F) Assembly** for use on the W88/Mark 5 Reentry Body of the Navy's D5 Trident II missile. The assembly has the greatest range of capabilities of any integrated AF&F assembly designed by Sandia. In 13 Stockpile Surveillance tests completed in 1991, all systems functioned as planned, attesting to the quality of the design and the Sandia-monitored manufacturing process. (5100)

The most extensive accumulation of nuclear safety features to date is being incorporated into the **MC4255 firing set**, originally designed for the SRAM-T and now extended to the Multi-Application Surety Technology (MAST) program. Features include wireless power coupling through transformers in rotating wheel stronglinks; Mylar capacitor weaklinks; stainless steel cases and covers for strength, ductility, and weldability; exclusion region walls of 0.07 inch or greater for lightning protection; and a welded exclusion region wherever possible. The biggest innovations include an integrated mounting deck with the firing set connected to the nuclear explosives package with a tape joint — representing a significant improvement in stockpile nuclear safety. (2300)

## Pulsed Power Development

Sandia began target experiments on the **Particle Beam Fusion Accelerator (PBFA) II**. Focused ion beams were used to drive a variety of cylindrical, conical, and spherical targets as part of the investigation of Inertial Confinement Fusion. The beams had power densities of two to three terawatts per square centimeter. These are the first sophisticated and well diagnosed target experiments with intense ion beams, and they mark the beginning of a new era of light-ion and heavy-ion fusion experiments. (1200)

A team of Sandia researchers developed **SNIPER** (subnanosecond impulse radiator), the nation's highest-power repetitive-impulse transmitter, and used it to conduct a series of high-priority DoD field tests. SNIPER's two gigawatts of peak electric power, 250 picoseconds of rise time, and pulse repetition frequency of more than 1,000 hertz make it about two orders of magnitude greater in power than other transmitters. (1200)

Sandia's **Saturn** accelerator now has world-class test capability to do cold X-ray testing of nuclear weapon survivable components through

new techniques for debris mitigation in X-ray experiments. The z-pinch plasmas used to produce X-rays are accompanied by debris that is detrimental to a test. Sandia was able to mitigate

the bulk of the debris and make transmission windows that kept test samples clean. External customers were delighted when researchers increased the debris-free fluence area by 100 times. (1200)



SANDIA TECHNICIANS Dora Derzon (left) and Patti Sawyer (both 1276) assemble a target chamber for PBFA II.



# Energy/Environment

Solar detoxification of groundwater was successfully demonstrated for the first time at an actual cleanup site through a joint effort involving Sandia, the National Renewable Energy Laboratory (NREL), and Lawrence Livermore National Laboratory (LLNL). The federal Superfund site at LLNL has major groundwater contamination resulting from the discharge of chlorinated solvents in the 1940s. During a year-long experiment, researchers demonstrated that the contaminants can be destroyed by the solar process and measured several variables affecting the efficiency of the process. Sandia's extensive experience with large-scale solar detoxification systems helped make the LLNL solar system a reality. Sandia is currently working with NREL and industry to transfer the detoxification technology to the private sector. (6200)

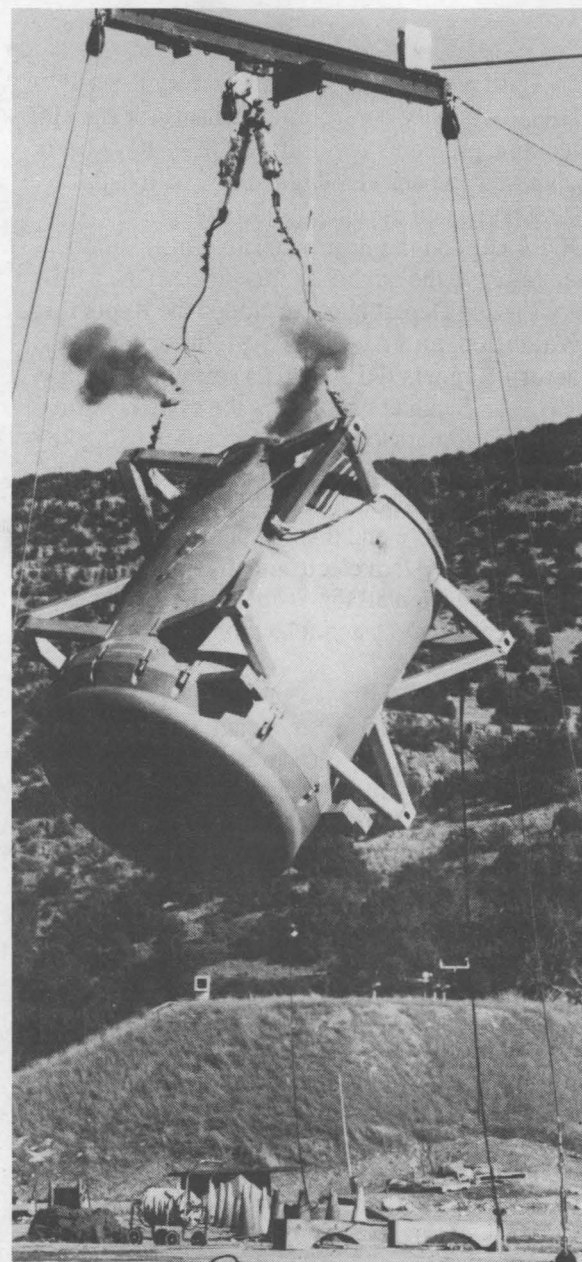
Sandia developed and demonstrated a seismic technique for monitoring waste remediation processes — in this case, the removal of trichloroethylenes from soil. The monitoring technique is based on the principle that seismic wave velocities change when water saturation of the ground changes. At DOE's Savannah River plant, where air was pumped into the ground to extract the contaminants, Sandia was able to monitor the effectiveness of the air stripping operation by measuring seismic waves before the air was injected and again during the injection. Scientists were thus able to map regions where water saturation had decreased as a result of the injected air. This imaging can identify which subsurface regions are truly being remediated as a function of both the geometry of the air injection wells and variations in the rock or soil units. (6200)

Sandia entered a partnership with Thiokol Corp. of Utah to examine and develop innovative methods for large rocket motor disposal. The armed services have significant inventories of such motors, and their disposal is necessary to meet treaty verification and normal maintenance needs. However, safe and environmentally benign disposal methods have yet to be demonstrated. Disposal inventories are increasing and will exceed storage capacity in future years. Key elements of the Sandia-Thiokol effort are efficient removal of propellant from the motors and subsequent processing of the waste stream. The project draws on Sandia's systems engineering expertise and Thiokol's propellant chemistry and rocket motor manufacturing experience. (5300)

Sandia is helping to expand the use of solar power systems to Honduras, Guatemala, and other parts of Central America, where a large percentage of the population is rural and has no access to electricity. Sandia is sharing its photovoltaic expertise with a variety of organizations, such as Enersol in the Dominican Republic and the National Rural Electric Cooperative Association's Central American Rural Electrification Support Program in Guatemala. In addition, Sandia, DOE, the Commerce Department, and the US Export Council on Renewable Energy have entered into discussions with the Guatemalan Minister of Energy to develop a solar-based rural electrification program called PERSOL. These approaches are helping to promote worldwide use of renewable energy technologies as well as expand markets for US products and services. (6200)

Sandia contributed to combustion science with a new explanation for the formation of the first aromatic compound or "first ring," a critical step in the formation of hydrocarbons and soot in flames. The mechanism identifies singlet methylene as a critical chain carrier in the formation of hydrocarbons that produce aromatics. Using a combination of flame modeling and electronic structure theory, Sandia researchers showed that, contrary to earlier proposals, reactions of hydrocarbons with acetylene are insufficient to account for the levels of benzene found in flames. Sandia has incorporated the new mechanism into its computer codes to improve the understanding of how fuel-rich combustion leads to formation of larger and larger molecules, leading ultimately to pollutant soot. (8300)

Over the past 10 years, Sandia has managed much of DOE's program to develop advanced rechargeable batteries for energy storage and electric vehicles. The sodium-sulfur technology, developed for Sandia primarily by Beta Power Inc., has now been selected by the US Advanced Battery Consortium as its leading candidate for initial market requirements. Recently, Beta Power Inc. completed conceptual designs of an optimized sodium-sulfur cell and battery that dramatically increases performance and economic potential. The improved cell design has substantially fewer components than existing cell designs, yet has 50 percent more energy capacity and nearly 100 percent more peak power. (2500)

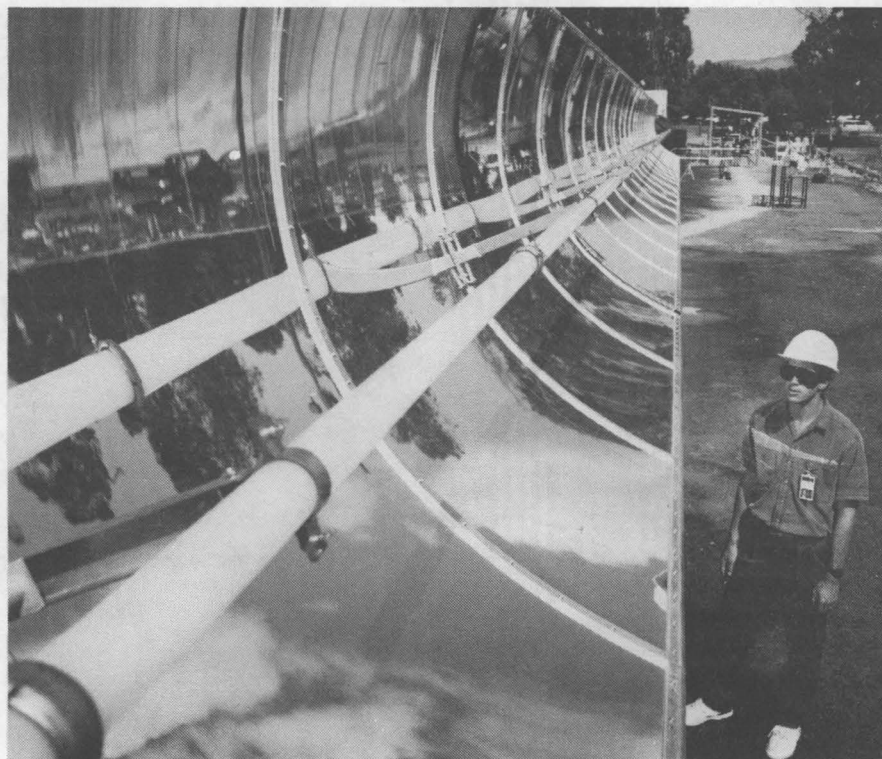


THE ON-SITE CONTAINER is designed to prevent ignition of explosives and release of lethal chemical agents from chemical munitions that are being delivered to destruction sites.

Sandia designed and developed a catalyst for converting carbon dioxide that has potential applications in producing environmentally friendly liquid fuels such as methanol or designing selectively permeable membranes. Such applications are being pursued in collaboration with Amoco Oil and Monsanto Corp. The catalyst for binding and activating carbon dioxide was one of a series of molecules with selective binding cavities that were computer-designed at Sandia using molecular modeling methods. The most promising of the catalysts were then synthesized and characterized in collaboration with the University of California at Davis, Amoco Oil, and Monsanto using a variety of techniques, such as nuclear magnetic resonance, resonance Raman spectroscopy, and X-ray crystallography. The experimental structural information thus obtained validated the molecular structure that had been predicted by the molecular modeling calculations, including substrate binding in the cavity. (6200)

Sandia completed the design, fabrication, and testing of an On-Site Container (ONC) for chemical munitions, an integral component of the chemical demilitarization program established by Congress to destroy existing stockpiles of chemical weapons. The ONC is designed to limit thermal and structural damage to battle-ready chemical munitions in order to prevent ignition of explosives and release of lethal chemical agents in the event of a transportation accident. The ONC will provide a safe and efficient means of transport from chemical munition storage sites to incineration facilities. Production of 165 units will begin this year. (6300)

TECHNIQUES FOR SOLAR detoxification of groundwater developed at Sandia are being used to clean up a federal Superfund site at Lawrence Livermore National Laboratory. In this photo, Mark Mehos of the National Renewable Energy Laboratory (formerly the Solar Energy Research Institute) checks the operation of the parabolic trough system Sandia helped design and install.





# Energy/Environment

Sandia helped prepare the Integrated Systems Checkout (ISC) of the **Waste Isolation Pilot Plant (WIPP)**, a full-scale functional test of all people, parts, and procedures needed to initiate the Dry Bin-Scale Transuranic Waste Test. The ISC lasted about two weeks and completed a year-long effort that resulted in the Declaration of Readiness for the first shipment of waste to the site — a major WIPP milestone. Sandians played key roles in all aspects of the test, from design and implementation to review and resolution. A DOE team conducted an Operational Readiness Review of safety and technical aspects, and noted the exemplary quality of the affidavits supplied by Sandia. (6300)

The US Nuclear Regulatory Commission sponsored several research programs at Sandia to study the safety implications of **hypothetical "core meltdown" accidents** in nuclear reactors. Large-scale tests at Sandia's Large Melt Facility investigated the effect of adding water to molten core materials at temperatures higher than 1,900 degrees K. These experiments demonstrated Sandia's capability to perform state-of-the-art, high-temperature tests using up to 1,100 pounds of molten material. The results are being used to evaluate current and future reactor containment designs and accident mitigation strategies. (6400)

In studies for the **Yucca Mountain Project**, Sandia predicted the behavior of an underground repository for highly radioactive waste. Researchers completed a study of the suitability of a potential repository site in Nevada, evaluated 34 proposed designs for an underground test facility, and did a probabilistic estimation of the radioactivity that might escape from a repository system over 10,000 years. Sandia's geotechnical expertise helped achieve a major milestone: collection of the first field data from surface-disturbing tests at the site. (6300)

## Quality

The W89 Gas Transfer System received an outstanding rating from DOE in a **DOE Quality Criteria (QC-2) survey**. QC-2 sets minimum quality principles and criteria for research, design, development, and test activities in the nuclear weapon program. Each DOE contractor must have a written quality policy and a defined quality system. With the focus on the customer, the W89 SRAM II Gas Transfer Group reviewed the QC-2 criteria, developed a response to directly answer each item, and documented a quality approach. The DOE survey team applauded the group for its use of Quality Functional Deployment techniques, outstanding commitment to quality principles and practices, demonstrated leadership, and design practices. (8400)

A team of certified examiners from AT&T scored a quality self-assessment submitted by the Purchasing & Materials Management (PMM) Directorate 3700 based on the **Malcolm Baldrige National Quality Award** criteria. PMM received a score of 304 out of a possible 1,000, which examiners rated as "favorable for a first-time applicant." Department meetings were held to share the results with employees and give them an overview of the Malcolm Baldrige award. Supervisors then attended a leadership conference to develop an improvement plan for FY92. This plan focuses on data analysis, cycle time reduction, and personnel growth and development, and was shared with all employees. Another self-assessment is planned for FY93. PMM's goal is to make a significant improvement. (3700)

Sandia developed a miniature **sensing unit that selectively responds to chlorinated hydrocarbons**. The briefcase-size system, funded in part by DOE's Environmental Restoration and Waste Management office, consists of a coated surface acoustic wave device and associated electronics. A portable acoustic wave sensor uses a novel data collection method that applies frequency shift and attenuation (patent pending) to discriminate between chemical species. Detection limits are in the parts-per-million range for various chlorinated hydrocarbons. Planned uses include process control at Allied-Signal and environmental monitoring at other DOE sites. (1800/1300/2300/6600)

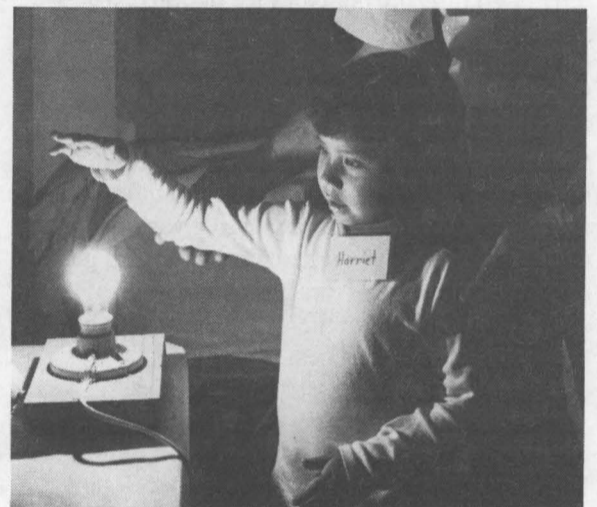
Working with industry, Sandia developed a special-purpose, **lightweight epoxy grout system** for sealing and isolating oil reserves from the envi-

ronment. Now commercially available, the system will be used at the Strategic Petroleum Reserve in Louisiana, where the epoxy will be floated on crude oil in underground reserves to form bulkhead seals in several mined openings with access to 73 million barrels of oil. The epoxy will save DOE millions of dollars in construction costs and reduce the vulnerability of the site to an oil spill during construction. Other uses are being investigated. (6200)

The Nuclear Regulatory Commission's release of a study assessing severe **accident risks at five nuclear power plants** included data from Sandia technical studies. Sandia also completed work for the LaSalle nuclear power plant and demonstrated risk assessment techniques in accident management that have led to new standards for assessing risks in hazardous facilities. (6400)

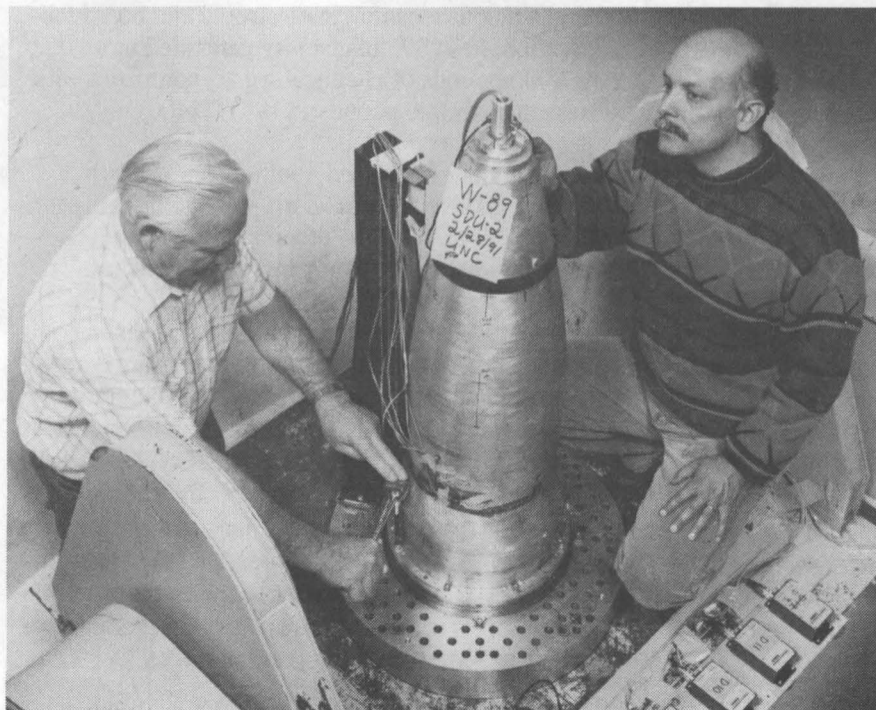
## Education Outreach

The **Science Advisors (SCIAD) Project** sent Sandia scientists and engineers to public schools throughout New Mexico to help teachers one day a week during the academic year. Science advisors serve as a resource to teachers in Albuquerque Public Schools, Bureau of Indian Affairs Schools, and rural schools, helping them to develop hands-on teaching materials and extend their knowledge of scientific principles. In some cases, advisors help teachers lead classroom discussions and demonstrations. The project has been so well received that it has now been replicated by a consortium of agencies in southern New Mexico and is being considered as a model elsewhere in the country. With expansion of the program in FY92, more than 200 schools will be participating. (35)



A LA MESA Elementary School youngster participates in an optics demonstration on color, light, and shadows presented by Sandia volunteers. (Photo by Randy Montoya, 3162)

Quality initiatives enabled a team of Sandians and representatives from the EG&G Rocky Flats production facility to solve two major problems on the **W89 JTA Receiver**. Their goals were to minimize porosity in the main structural weld of the receiver and to formulate a plan for weld process development prior to welding activity. To achieve this, they used Quality Function Deployment and Design of Experiment methods. Their efforts substantially reduced the cost and time of the weld development program, and avoided costly redevelopment and redesign. (8400)



ROGER SMITH (left, contractor) and Don Lind (5354) prepare to test the nose cone of a W89 warhead at Sandia, Livermore. Sandia received an excellent rating from DOE in its first QC-2 (Quality Criteria-2) survey, which reviewed the W-89 program.



# Components/Materials and Processes

In collaboration with NASA Lewis Research Center, Sandia predicted the lifetimes of **radiation-cooled rocket thrusters** for possible use in interplanetary missions and communication satellites. The rocket thrusters are built with a special material developed by Aerojet and Ultramet that is prepared by chemical vapor deposition of iridium on rhenium and that can operate at temperatures higher than 3,600 degrees F. Sandia provided fundamental studies of the diffusion processes that limit the lifetime of these thrusters. The studies allow predictions and improvements of lifetimes at much lower cost than full-scale testing. The studies also allow predictions to be made for altered operating conditions such as those that might exist on a space station. The Sandia tests showed that the failure mechanism is caused by grain boundary diffusion of rhenium through the iridium coating, followed by rapid oxidation. The work is funded by NASA Lewis Research Center. (8300)

Sandia delivered a variety of **radiation-hardened microprocessors** for national space applications. These devices, from the SA3300 microprocessor family designed at Sandia, will be used in NASA Goddard's International Solar Terrestrial Physics program and Caltech's Mars Observer Camera. These programs continue the exploration of the solar system and require integrated circuits that can operate in a variety of radiation-harsh environments for extended periods. The microprocessors were fabricated at AT&T and can extend the useful operating lifetime of deep space probes. (2300)

Sandia was selected the lead DOE laboratory for **computer design of materials and molecules**. Under this program, researchers are developing massively parallel quantum mechanics and molecular dynamics models. These developments will have an impact on catalysis, microelectronics, and structural materials. Sandia's 1,024-processor nCUBE 2 completed a quantum-mechanical simulation involving 512 atoms. This represents an order of magnitude increase in capabilities. (1400/1100/6200/8300)

Sandia continued its program in **Environmentally Conscious Manufacturing**, focusing on cost-effective elimination of hazardous and toxic waste generated in the production of electronic and electromechanical components for nuclear weapons. In collaboration with the Allied-Signal Kansas City plant, Sandia is demonstrating the manufacture of a B61 Programmer using environmentally safe materials and processes. Using new technologies to the greatest extent possible, Sandia will integrate printed wiring boards, printed wiring assemblies, cables, metal parts, and the baseplate. The prototype will be completed by the end of FY92 and will be tested and compared to other samples for functionality. Meanwhile, Sandia will also develop cost-benefit and waste minimization metrics. (6600/1800/2400)

Sandia provided technical support to Spectra Diode Labs in the development of a **fiber-optic coupled laser diode** for the SRAM-T system. Laser diode ignition reduces the electrostatic and electromagnetic sensitivity of explosively actuated systems. The laser diode and optical fiber are encased in a hermetic package that can be directly connected to standard fiber-optic components. The maximum optical output from the fiber, which is 100 micrometers thick, is 1.2 watts over a wide temperature range. This development significantly reduces the price of this laser diode package, which is now being offered commercially by Spectra Diode Labs. (2500)



MARIA ARMENDARIZ (6613) tests operation of printed circuit boards after they have been subjected to environmental extremes such as humidity and heat. Her work is part of a cooperative research project between Sandia and Motorola. (Photo by Mark Poulsen, 3162)

Sandia implemented two new approaches to **procuring war reserve components** (components developed for stockpile use) for the Nuclear Weapons Complex. The Manufacturing Development Engineering Demonstration Project allows procurement of 10 components from commercial entities and includes budget analyses, other milestones, and schedules for product conception through delivery. The Design Delegation Project demonstrates the feasibility of transferring design responsibility to production agencies. Teams review procurement of components, semiconductors, and electric cables. These projects will increase the options available to DOE and Sandia in distributing work within a restructured Nuclear Weapons Complex. (2500)

Sandia's **Printed Circuit Facility** implemented several environmentally conscious manufacturing processes that have dramatically reduced the amount of hazardous and chemical waste. Since 1988, the facility reduced its use of chlorinated solvent by more than 90 percent by incorporating aqueous processing of solder mask and photoresists. As a result, the use of trichloroethane and methylene chloride was cut by more than 100 gallons per week. Currently, all chlorinated solvents have been replaced with terpene, alcohol, and aqueous cleaning in electronic and board fabrication. In 1989, this facility generated more than 57,000 pounds of chemical waste, compared with less than 13,000 pounds in 1991. (2400)

Sandia established a joint program with Westinghouse Electric Corp. to develop radiation-hardened, electrically alterable, **non-volatile semiconductor memory integrated circuits** (ICs) for weapon and satellite applications. Such ICs are used to store weapon access codes in command and control systems and to program computer memory just prior to hardware integration. The team developed a non-volatile 64K-bit Silicon Oxide Nitride Oxide Silicon (SONOS) Electrically Erasable, Programmable, Read Only Memory. Sandia is responsible for memory design and technology, Westinghouse for integrated circuit fabrication. The team has produced initial prototypes and expects to deliver high-reliability products for satellite and weapon integration in FY93. (1300)

Sandia established the **Center for Solder Science and Technology** to promote and coordinate solder research, development, and applications throughout the DOE complex and the country's manufacturing base. The purpose is to advance the understanding of solder and soldering processes and to improve component reliability and environmental health. Currently, researchers are establishing acceptable replacements for hazardous chemicals used in cleaning, developing lead-free solder alloys and new fluxless soldering technologies, and constructing models that predict the lifetime of solder joints. (1800)

Sandia developed processes using a **non-hazardous gold sulfite electroplating solution** to fabricate intricate gold patterns for microelectronic devices. This solution replaces a standard gold cyanide solution classified by the Environmental Protection Agency as acutely hazardous. It is used to form fine line conductors, miniature gold air-bridge crossovers, and other patterns as small as 2 micrometers on gallium arsenide, silicon, quartz, and ceramic substrates. (2400)

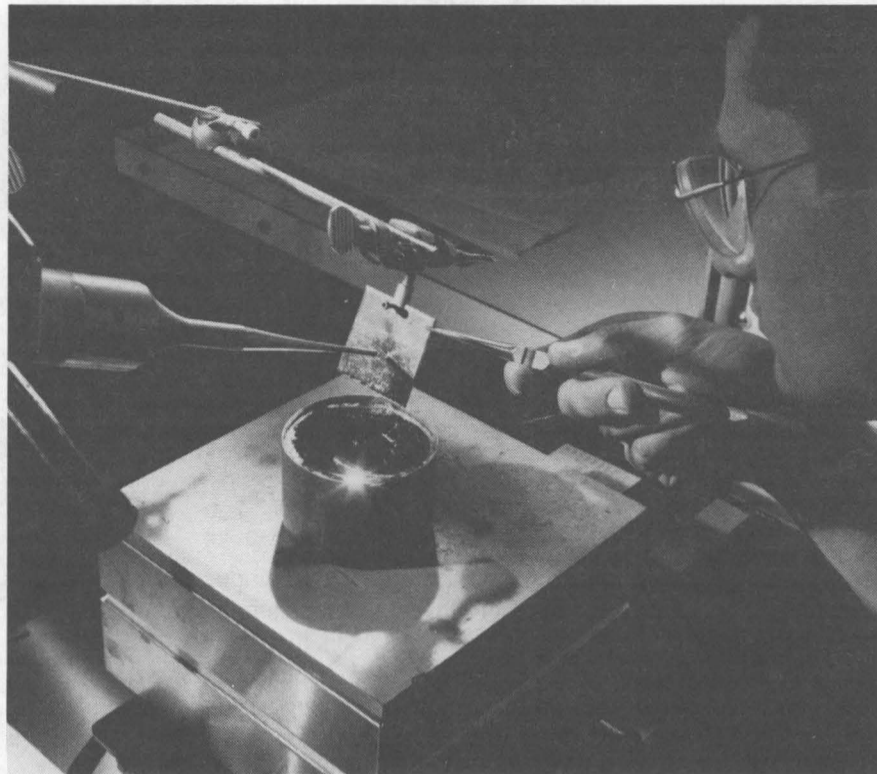
Sandia completed an 18-month study of an advanced concept for **tritium gas transfer systems** (GTS) for nuclear assemblies. The study, based on tritium research at Sandia in the late 1970s and at Sandia and Los Alamos National Lab in the late 1980s, concluded that the concept offers stockpile enhancements and is ready for component development. To complete the study, researchers measured and defined material properties, reviewed the aging behavior of materials exposed to tritium, conducted experiments with aged materials, built physical models, and extrapolated the results to stockpile use. To prepare the concept for design engineering, they built a gas transfer model, conducted radiographic and tritium transfer tests that verified the expected behavior of new and aged materials exposed to tritium, prepared an algorithm and design code for gas deliveries during stockpile life, built hardware and placed it in tritium storage, and developed non-destructive test procedures. The study had cooperation from the EG&G Mound plant and the Westinghouse Savannah River Site. (1500/1800/8200/8300/8400)



# Components/Materials and Processes

Sandia developed a process to produce **high-field varistors** for use as voltage regulators in weapon subsystems. Process development included everything from scale-up and optimization of a chemical preparation process patented by Sandia to development of ceramic billet information, firing parameters, machining procedures, and electrical screening tests. Improved properties include increased high-voltage stability, no open porosity, and microstructural homogeneity. (2400/1800/2500)

A **non-cyanide copper plating bath** has been qualified by Sandia for use throughout the DOE weapon manufacturing complex. The new formulation uses copper pyrophosphate, a safer chemical that does not require special waste separation or waste handling equipment. Laboratory testing has shown that the new coating also has superior adhesion properties. Full-scale tests at the Martin Marietta Y-12 plant and the Allied-Signal Kansas City plant indicate the pyrophosphate system can be readily used in a manufacturing environment. Along with other cyanide replacement projects supported by DOE's Environmental Restoration and Waste Management Office, the copper substitution project has resulted in



several completely cyanide-free operations within DOE. Efforts are under way to transfer this tech-

nology to independent plating facilities in California, New Mexico, and other states. (8300)

PAUL VIANCO (1831) demonstrates the ultrasonic soldering process, an environmentally friendly way of producing circuit boards without using fluxes or pre-cleaning solvents. Sandia's Environmentally Conscious Manufacturing program focuses on cost-effective elimination of hazardous and toxic waste generated in the production of weapon components.

## Technology Transfer

From January through September 1991, Sandia obtained approval for 13 **Cooperative Research and Development Agreements (CRADAs)** with industry, more than any other defense programs laboratory. At the end of FY91, 59 CRADAs had been initiated — 20 were submitted to DOE's Albuquerque office for approval, and another 39 were in various stages of preparation and negotiation. As of Sept. 30, companies working with Sandia included Motorola, Signetics, National Semiconductor, PermaCharge, Stellar, Vindicator, Dow Corning, Watkins Johnson, BPLW, Olin Hunt Specialty Products, Schumacher, United Technologies/Pratt & Whitney, and LSI Logic. (4200)

Sandia initiated a project to develop, demonstrate, and transfer technologies to support **cleanup of environmental contamination**, particularly at landfills in arid environments. The Mixed-Waste Landfill Integrated Demonstration Project will share technologies that characterize and remediate landfills containing complex mixtures of heavy metals, organics, and radioactive waste. Using two landfills at Sandia, the project will incorporate technologies from DOE, industry, and universities to solve a nationwide problem. (6600)

A **head gasket instrumented with ionization probes** developed at Sandia was successfully demonstrated at the General Motors V-6 Powertrain Division test facility in Flint, Mich. This project was motivated by GM's interest in diagnostic tools for studying cylinder-to-cylinder and cycle-to-cycle differences in combustion performance and Sandia's desire to demonstrate the viability of this technology. The probes detect the arrival time of the flame and provide spatial information about its location. The ionization probe wiring for the 3800 engine (3800 refers to a particular V-6 engine with 3.8-liter displacement) was made in Sandia's electronics fabrication laboratory using printed-circuit-board technology. For the test, a GM single-cylinder engine was operated at 1,300 to 2,000 rpm. Efforts are under way to commercialize the technology. (8300)

Sandia encouraged greater local participation in the Labs' technology transfer program by establishing the **Technology-Based Regional Economic Development (TRED)** Program. This program assists new small New Mexico companies that need manufacturing and marketing counsel as well as Sandia's technology know-how. Features of the program, which is coordinated with the state's Small Business Development Centers, Cooperative Extension Service agents, and the Manufacturing Productivity Center, include tours of Sandia, technical workshops and seminars, and one-on-one interactions to promote the use of Sandia capabilities that are not readily available elsewhere. It is not intended to provide services that can be obtained commercially. (4200)

Sandia is collaborating with the Norton Co. and Integrated Systems Inc. to improve production of **Chemical Vapor Deposited diamond**, used for heat-conducting electronics packaging. Significant developments include theoretical studies that have identified optimal operating conditions and major gas-phase diamond precursors, as well as surface science experiments that have yielded elementary reaction rates on the diamond surface. This data is being used to create intelligent process control, with the help of in-situ optical sensors that are under development. (8200/8300/1100)

Semiconductor devices in the late 1990s will require new **patterning technologies** that can print line widths of 0.2 micrometers or less. Sandia, in collaboration with AT&T Bell Labs, has demonstrated the ability to pattern features as small as 0.05 micrometers using soft X-ray reduction optics and 140-angstrom radiation from a compact laser-plasma source. These results were obtained through a combination of Sandia's expertise in laser-plasma sources and Bell Labs' expertise in soft X-ray optics. The laser-plasma source is a possible alternative to expensive, complex synchrotrons and could significantly influence the future commercialization of X-ray projection lithography to produce integrated circuit devices. (8300/8400/6400/2700)

The Albuquerque Fire and Rescue Department asked Sandia to analyze, design, and construct a modified **"Arroyo Rescue Curtain."** Completed this year, the curtain is designed to stretch across a flooding arroyo at an angle so a victim can catch it and be steered to shore. (1500)

**Carbon foam materials** originally developed by Sandia for defense applications are now being considered for use in lithium ion rechargeable batteries to power electrical vehicles and consumer devices such as computers, cellular phones, toys, and pacemakers. The materials exhibit excellent lithium-ion intercalation efficiency, a term that describes the reversible insertion of a guest molecular structure, in this case a lithium ion, into a host structure without altering the structural features of the host. To date, lithium rechargeable batteries have not been commercially viable because of limited recharge lifetimes, in large part the result of problems with lithium anodes. However, anodes made with the Sandia-developed foams have demonstrated more than 2,000 recharge cycles in small-scale tests. These carbon anodes could provide a significant breakthrough for the US battery industry in a highly competitive global market. (8400/8300/2500/1800)

Sandia completed its second year of support for SEMATECH, a consortium dedicated to improving **US competitiveness in semiconductor manufacturing**, through the Labs' Semiconductor Equipment Technology Center. Sandia provided support in three major areas: equipment improvement, equipment enhancement, and modeling and advanced methodologies. Sandia developed a Reliability Analysis and Modeling Program to calculate machine reliability; improved the processing and control of plasma manufacturing by isolating the plasma discharge in plasma etching reactors from the effects caused by variations in radio-frequency power sources; and improved chemical vapor deposition models by incorporating radiative heat exchange and accurate chemical reactions. (1300)



# Testing

The Sandia-developed Laser Tracker 3 is a mobile, self-contained tracking system that operates up to a range of 50,000 feet.



Sandia conducted high-performance **water entry tests** using 1/10th-scale models of advanced penetrator shapes at impact velocities of up to 1,050 feet per second and decelerations greater than 1,000 times the force of gravity for several milliseconds. The conically shaped 1/10th-scale models were equipped with a Sandia-designed microminiature digital data recorder that made pioneering measurements of base pressure and deceleration in the unsteady hydrodynamic environment. A unique feature of the test hardware was the small instrumentation package, which is only about three inches long, including the battery. (5100/1500)

Sandia provided new or modernized **test capabilities for various weapon systems** tested at the Weapons Evaluation Test Lab at the Pantex plant. The effort included centrifuge test capability for the W62, B57, and B61; modernized system test capability for the B57; and a small centrifuge test system. Each of these systems was brought on-line after approval by a Test Program Validation team. These accomplishments will provide continuing test equipment capability in support of DOE's Stockpile Surveillance Program. (300)

Spherical Compton diodes are devices used to measure extremely **high photon exposure rates** during underground or aboveground radiation testing. Sandia has developed an extremely efficient computational procedure for determining the response of such diodes to photons of a given energy. The procedure significantly improves the ability to predict the response of such devices and optimize their design. The procedure uses a coupled photon-electron transport code developed by Sandia and Los Alamos National Laboratory. The result is improved diagnostic capability. (9300)

Sandia completed development of the **Laser Tracker Three (LT3)** instrumentation system, a mobile, self-contained, high-agility tracking system that provides photometric and trajectory data for experiments involving motion. LT3 can track experiments traveling at virtually any velocity to a range of 50,000 feet. On-board data reduction capabilities provide the customer with quick information. An absolute ranging system allows LT3 to track flying targets and provide three-dimensional information on time, space, and position from a single station. This new capability has been used several times on helicopters and aircraft. (2700)

Sandia's **Transportable Triggered Lightning Instrumentation Facility (SATTLIF)** makes it possible to conduct triggered lightning tests of buildings that cannot be tested in a conventional lightning simulator. SATTLIF is a fully self-contained facility that launches small rockets trailing a fine wire to trigger lightning strikes and then measures responses in and around the item being tested. SATTLIF was fielded at Ft. McClellan, Ala., for tests on a weapons storage bunker (igloo). The facility collected more than 300 measured response waveforms from 23 test points in and around the igloo during nine lightning flashes. The data will be used to validate computer models of the effects of lightning on complex structures. (2700)

Sandia participated in a weapons effect test known as **DISTANT ZENITH**, conducted by the Defense Nuclear Agency (DNA) at the Nevada Test Site in September. During the test, Sandia successfully fielded containment measurements, earth-motion experiments, seismic measurements, pipe diagnostics, pipe-closure monitors, radiation diagnostics, beam-definition experi-

ments, electromagnetic field measurements, a helium monitor, and recording-development experiments utilizing a 330-channel data acquisition system. This included 84 channels of high-frequency recordings for DNA. The primary goal was to study radiation-induced effects on electronic systems. All of Sandia's high-frequency channels and half the DNA channels were brought up-hole on fiber-optic links and recorded in a permanent recording facility. (9300)

Sandia tested several **radioactive or hazardous materials shipping containers** for development or certification purposes. The tests included impacts at speeds of up to 400 feet per second and fires lasting up to two hours. Impact tests were conducted at the Aerial Cable Facility or Area 3 Drop Towers. Actual fires were conducted at the Lurance Canyon Burn Site, and simulated fire tests at the Radiant Heat Facility. Items tested for internal programs include the Safe Secure Transport, On-Site Container, AL-SX and AL-S4 containers, and a modified Helicopter Accident Resistant Container. Tests were conducted for the Army's Armament Research, Development, and Engineering Command and Westinghouse Savannah River Co. (300)

Sandia researchers have significantly improved the range of applications for the **Shock Induced Polarization (SIP) Gauge**, an inexpensive and reliable instrument for measuring detonator energy. Because the gauge responds directly to a shock wave, it can provide precise measurements of timing (to a resolution of less than two billionths of a second), flyer-plate velocity, and peak shock-wave pressure. Test data collected with high-speed instrumentation has demonstrated that the SIP gauge is one of the fastest means available for measuring the output from energetic devices. The gauge, which consists of electrodes on a thin piece of special plastic, produces signals of from 2 to 5 volts. The gauge signal is also very "clean," with little noise associated with it. Experiments correlating SIP gauge measurements with another method known as VISAR (Velocity Interferometer System for Any Reflector) show that the two techniques are within 10 percent of each other. Enough tests have been done with SIP gauges to determine that the standard deviation is around 10 percent. Additional improvements are planned that will allow the gauge to be directly coupled to a 50-ohm cable and provide the capability to verify the integrity of the gauge after it has been installed. (300/2500)

## Supporting Technologies

A Sandia research team developed the first electrically controlled semiconductor device that changes reflectance for 1.06-micrometer light. The device, called a **reflectance modulator**, can receive and reflect light waves from a distant source, allowing messages to be sent from a remote location. It has its greatest potential application in communication systems. It is constructed using strained-layer superlattices, which were pioneered at Sandia in the early 1980s. Strained-layer superlattices consist of layers so thin that the atoms line up easily with those of a different material without causing defects such as threading dislocation. This permits fabrication of semiconductor materials with completely new electronic and optical properties. The Sandia team won an R&D 100 award for the device. (1100)

A new **Microelectronics and Photonics Applications Center (MPAC)** at Sandia helps assure the availability of microelectronic and photonic components for government needs. MPAC has two major goals: to develop and provide the government with manufacturing access to custom components and to strengthen the competitive position of the US microelectronics and photonics industry by helping industry develop the next generation of manufacturing processes and equipment. MPAC will share Sandia's expertise with both silicon and semiconductor materials and devices. (1300)

**Safe operation of robots** requires that the robot follow a path that does not collide with other objects. Sandia has developed and implemented

several new programming techniques that reduce, by an order of magnitude, the time it takes for a robot to automatically find a safe path. Sandia is now working with a commercial software company to integrate this technology into its products. (1400)

Sandia developed **advanced microelectronic packaging** technology capable of reducing the size of electronic systems by an order of magnitude. The technology combines Sandia's expertise in micromachining silicon with industrial advances in miniature copper polyimide interconnect films. The technology gives Sandia the capability to package tens of bare integrated circuits into the same silicon substrate cavity. (9100/1300/1500/1800/2300)



# Supporting Technologies

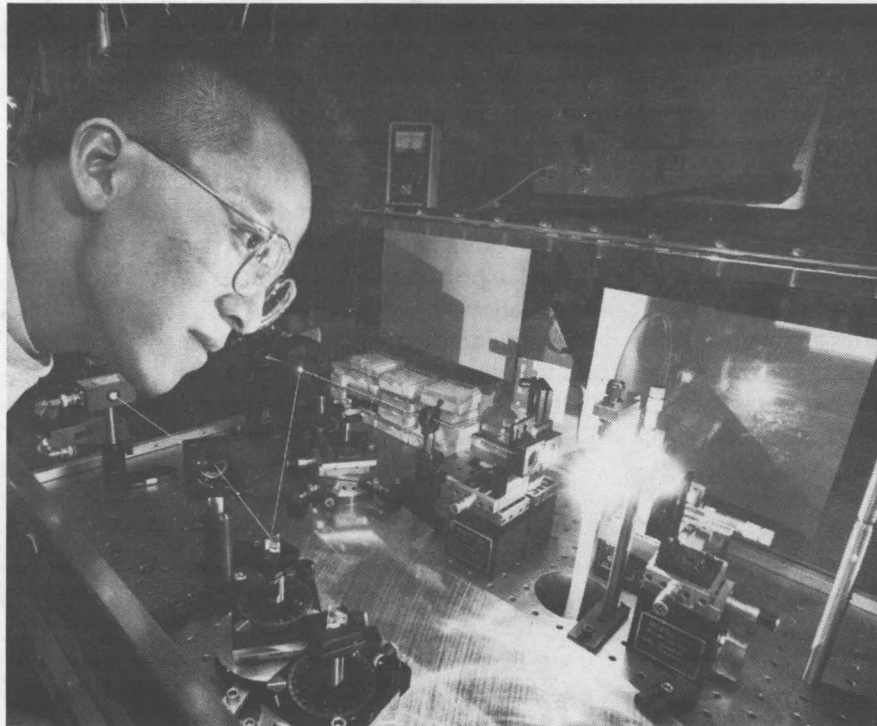
Sandia participated in an industry-led effort to develop an implementation plan for the **National Initiative for Product Data Exchange**. The proposed digital system will result in shorter development cycles, higher quality, and lower costs. All information will be presented in an internationally accepted format to provide an unambiguous computer-interpretable definition of the physical and functional characteristics of a product. The system will also provide information about a product's complete life cycle. Suppliers, vendors, and manufacturers will be able to easily receive and supply information about specific parts and the interrelationship of parts and materials. (2800)

Sandia developed a new **Interfacial Force Microscope** that can examine adhesive forces with atomic-scale resolution. This ability makes it possible to identify fundamental mechanisms of adhesion and now provides a direct means of studying the atomic-level processes that bind solid surfaces together. A unique force-feedback control system in the microscope overcomes the mechanical instability inherent in all previous atomic-force microscopes and permits examination of the entire curve of adhesive force vs. interfacial separation. The first studies with the new microscope have demonstrated the lubricating effect of atomically ordered organic layers adsorbed on metal surfaces. (1100)

Sandia completed the first FALCON (Fission Activated Laser Concepts) laser-scaling experiment in the Annular Core Research Reactor, a key milestone of DOE's reactor-laser program. The experiment was the first demonstration of the lasing and beam quality potential of the FALCON concept under large laser system conditions. The experiment addressed key issues of the quality of the laser medium in a flowing system configuration and confirmed the capability to scale this technology up to megawatt-class power levels and still retain high beam quality. (6400/1100)

Sandia won a technical competition held by the Defense Advanced Research Projects Agency to select a principal sponsor for **three-dimensional hydrocodes** used by government agencies and contractors to design advanced penetrators and armors for the Army. In this capacity, Sandia is providing advanced modeling capabilities and user services for CTH, a production hydrocode, to participating organizations in the Army's Armor/Anti-Armor Program. This program is expanding Sandia's support role in conventional ordnance programs directed by DoD. (1400)

The ultimate achievement of semiconductor laser research is to demonstrate an intense, narrow-divergence optical beam originating from a single mode in an optical resonator. Sandia demonstrated, for the first time, the use of a **photo-pumped, two-dimensional surface-emitting laser array** to produce a dominant, on-axis beam. The solution to the technical problem of getting off-axis laser beams to operate in a symmetrical mode was to rephase the array wavefront with a phase layer. To accomplish this, the thickness of the phase layer was carefully chosen without modifying the mirror reflectivity for adjacent lasers. The definition of the laser pixels and phase plates was achieved with an ion-beam etching process. Researchers also redesigned the laser resonator to improve efficiency and reconfigured the pump laser to double pump power. The result was operation of up to 80 phase-locked lasers producing a symmetrical far-field pattern consisting of one dominant on-axis beam and some weaker off-axis beams. (1100)



STANFORD GRADUATE student Winston Fu studies the basic physics of lasers applicable to photonics, optical computing, and pattern recognition. Sandia joined the University of New Mexico, Los Alamos National Laboratory, and the Air Force's Phillips Laboratory in forming the Alliance for Photonic Technology, part of a larger initiative at Sandia to enhance US competitiveness in the microelectronics and photonics industries. (Photo by Randy Montoya, 3162)

Sandia designed and built a **high-flux neutron radiography facility** at the Annular Core Research Reactor (ACRR). The high-intensity thermal neutron beam is suitable for recording dynamic events with high resolution, such as chemical exchange propagation and flowing gas wave fronts. The facility uses an experiment cavity that passes through the center of the reactor core to create the beam, together with the ACRR's unique capabilities, to produce computer-controlled high-power square waves. Sandia has produced images with 1 millisecond of temporal resolution, and has reduced the time required to produce a film radiograph by two orders of magnitude. (6400)

Sandia took the first step in implementing elements of the Strategic Plan that improve technical processes. Seven "**Preferred Processes**" were published on the following topics: Project Planning and Management, Establishing Requirements, Design for Production, Managing Design Changes, Reviews, Software Development, and Removing Bureaucratic Barriers. These processes outline basic activities Sandia organizations can follow in defining and accomplishing work and meeting customer requirements. (2800)

By implanting oxygen ions into aluminum, Sandia produced **aluminum surface alloys** with strengths comparable to high-strength steels and with high-temperature microstructural stability. The alloys reduce wear by more than 10 times and unlubricated friction by five times, compared with an untreated aluminum surface. These properties

substantially exceed generally accepted limitations on aluminum alloys and are the result of a dense dispersion of nanometer-size aluminum oxide precipitates. The new alloys were produced through a program of ion-beam synthesis of engineered materials. (1100/1800)

A two-year pilot project at Sandia and Allied-Signal in Kansas City got under way in which employees at both sites can simultaneously view and work on the same design on their computers. Called **Interactive Concurrent Engineering (ICE)**, the technology will decrease the time needed to move from design to product development and permit early and iterative communication between engineers to resolve design problems. The Sandia-designed software enables team members to concurrently view, discuss, and manipulate a design while their computer displays change simultaneously to reflect their input. A proof-of-concept demonstration was completed in August 1991. (2800)

Sandia trained more than 100 Nuclear Weapons Complex employees at **Design For Manufacturing and Assembly (DFMA)** workshops, a tool for product realization within the Concurrent Engineering approach. Interdisciplinary teams use DFMA principles and software to analyze a product design, calculate assembly metrics, improve the design, reduce manufacturing costs, and maintain product performance. (2800/3500)

## Safeguards and Security

Together with Lawrence Livermore National Laboratory (LLNL), Sandia developed a new security vulnerability assessment model called the **Analytic System and Software for the Evaluation of Safeguards and Security (ASSESS)**. The model is based on a personal computer and gives security analysts an effective tool for evaluating insider and outsider threats at facilities. Sandians participated in teaching several ASSESS courses for DOE, the system's sponsor. Sandia completed vulnerability assessments using the tool for LLNL, Tonopah Test Range, Nevada Test Site, the Federal Aviation Administration, the Nuclear Regulatory Commission, and the Air Force, as well as for Sandia. Besides being widely used as a security

evaluation tool by DOE, the model has potential use at a variety of other agencies. (9500)

A new team was formed at Sandia, Livermore to take responsibility for Nuclear Explosive Area (NEA) testers — the electrical equipment connected to nuclear explosives. The team is called NETOG, for **Nuclear Explosive Tester Oversight Group**. NETOG members will be involved in design, analysis, modification, use, and retirement of NEA testers. The team has already performed tester safety analyses for the W79, W87, and B83 programs, and began overhauling applicable engineering procedures and design guides to ensure maximum safety. (5300)



# Non-Proliferation and Arms Control Verification

Sandia developed a new, more efficient system to review and analyze visual records of activities at nuclear facilities throughout the world. Called MIPS, for MIVS Image Processing System, the video surveillance review station will help the International Atomic Energy Agency (IAEA) verify the peaceful use of nuclear technology. MIPS reduces visual data collected by the Modular Integrated Video System, or MIVS, developed by Sandia in 1989. Currently, IAEA inspectors manually review data from 170 MIVS units deployed in nuclear facilities around the world. With the new system, the amount of data reviewed manually can be reduced by more than 90 percent. MIPS detects scene changes and has a neural network that identifies images showing significant activities. MIPS greatly reduces inspector review time and is being evaluated by IAEA inspectors for use in monitoring the Nuclear Non-Proliferation Treaty. (9500/9200)

Sandia obtained a new, general export license called SAFEGUARDS for use in the Labs' support of the IAEA and EURATOM (the group responsible for all nuclear activities in the European Community). This license became law July 23, when it was published by the Commerce Department's Bureau of Export Administration. This license reduces Sandia's export administration burden, the Commerce Department's workload in processing commodities and applications, and allows IAEA and EURATOM to re-export US commodities without contacting the US government. It improves the working relationship among those two organizations, DOE, and the State Department, and facilitates exports from US companies to IAEA and EURATOM. (3100)

The International Atomic Energy Agency (IAEA) benefited from new authentication equipment designed by Sandia that collects

information from nuclear facility operators for safeguards purposes. The equipment has been installed in two facilities in Japan. These systems collect video and sensor data from operator-supplied equipment for subsequent use by the IAEA. Both systems will improve the effectiveness and efficiency of IAEA safeguards. (9200)

When fully deployed, a new satellite data-processing system, the **Integrated Correlation and Display System**, will provide real-time nuclear detonation reporting to verify the Limited Test Ban Treaty. It would also disseminate nuclear strike information in the event of war. Sandia completed the first phase of development for the Air Force this year. Advanced capabilities include fusion of sensor data from multiple satellite systems; automated waveform analysis to identify, locate, and characterize events; and a rule-based expert system to confirm events as nuclear. (9200)

## Laboratories Support

A Sandia team received an R&D 100 award for a **sporadic cryptographic synchronization loss detection** method that "scales" for reliable operation at high communication line speeds. The new method initiates synchronization recovery when a measure of the randomness of the decrypted data crosses a threshold deemed to be uncharacteristic of proper operation. This method has been patented and is being integrated with the T3 (45 million bits per second) links that will consolidate Sandia's Livermore and Albuquerque supercomputing centers. Technology transfer of this development, expected to be useful to government agencies, banks, and other organizations requiring high-speed synchronization of encrypted links, is in progress. (1900)

Sandians may now play a more active role in revising or suggesting Labs policies by communicating with the newly established **oversight board for Sandia Laboratories Instructions (SLIs)**. The SLI Board will oversee Labs-wide policy development and streamline the approval process for new ideas. Board representatives are appointed from each vice presidency and serve as a liaison with employees. SLIs are written statements of Labs policy that spell out general objectives and reflect external requirements imposed by DOE, AT&T, and federal, state, and local governments. (100)

Employees were asked for the first time to anonymously provide feedback on the strengths and weaknesses of management through the **Upward Feedback** survey, a self-improvement tool for managers. The results of the survey forms are reported to managers in the form of charts and statistical analyses; individual comments are transcribed. Managers are encouraged to hold feedback meetings and develop action plans to address areas for improvement. In FY91, organizations 1 through 1000, 3000, and 9000 participated, with a high response rate of 80 percent. The FY92 survey will be completed this spring. (3500)

Sandia's **Integrated Procurement System** was redesigned to provide on-line, constantly updated data in a format that is easy to read and understand. The system culminates a three-year effort to improve the efficiency of purchasing, receiving, and payment processes. Customers can now track the progress of a purchase requisition, purchase order, invoice, or receipt with the help of user-friendly screens that provide the customer with on-line assistance. (100/3100/3700/8500)

**Volunteers in Action (VIA)** was one of 10 volunteer programs nationwide to receive the 1991 President's Volunteer Action Award. President Bush and National Volunteer Center Chair George Romney recognized Sandia for placing more than 1,000 volunteers in schools and community agencies. The volunteers provide a variety of services, such as math and science tutoring in high schools, literacy tutoring in the city jail, classroom science demonstrations, tree planting, mountain trail maintenance, and child abuse case monitoring. Some 50 community agencies and 50 public and private schools in the Albuquerque area benefited from these activities. (3100)

Sandia was one of 25 national recipients of the **US Small Business Administration's highest award, Category A**, for excellence in subcontracting with small, small disadvantaged, and women-owned businesses. Sandia's supplier network includes thousands of local and regional small businesses. (3700)

Security at the Livermore site earned the highest possible overall rating during the annual DOE field office **Safeguards and Security appraisal**.

In addition, two areas were singled out as deserving special recognition — the OPSEC (Operations Security) program, which was subsequently nominated for a national award, and the Security Force. (8500)

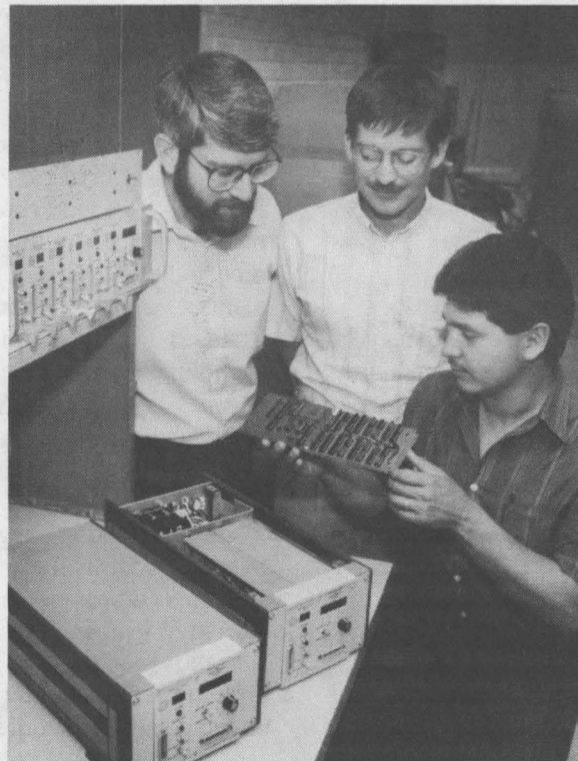
A **115-kv transmission line and two substations** with 12.47-kv secondary outputs will provide added power capacity with fewer system losses and greater operating and maintenance flexibility. Selected buildings and facilities in Tech Areas 1 and 2 will be switched to the higher-distribution voltage this year. (7800)

**Renovation of Bldg. 880** got under way, with 35 percent of the building — 70,000 square feet — currently under construction. Reoccupancy is scheduled for this spring and summer. The rehabilitation includes asbestos abatement; primary and secondary electrical distribution systems; heating, ventilation, and air conditioning systems; lighting, communication systems, and all walls, ceilings, and floors. This work encompasses the first two phases of a plan to rehabilitate the entire building. (7800)

The **Internal Secure Network (ISN)** became operational, culminating a multiyear project to convert Sandia's centralized computer networks to internationally accepted standards. Major components to be brought on-line include the CRAY Y-MP8/864, which runs a secure, multi-data level UNIX operating system that enforces data classification labels as data is transferred from one place to another. This implementation of ISN helped earn Sandia the 1991 **INTEROP Achievement Award** in the government business sector. (1900)

Sandia entered a partnership with AT&T Bell Labs, Lawrence Berkeley Laboratory (LBL), the National Center for Super-

computer Applications, and the universities of Illinois, Wisconsin, and California to collaborate on **BLANCA**, an experimental gigabit-per-second computer network between these sites. Sandia proposed extending the network to Livermore, which would enable high-speed computer communications between the Combustion Research Facility at Sandia, Livermore, and the Combustion Dynamics Research Lab at LBL. AT&T further agreed to extend BLANCA to Sandia's Massively Parallel Computer Research Lab in Albuquerque. The network was initially installed at Bell Labs' Murray Hill facility and LBL. (1900)



DATA COMMUNICATIONS hardware developed at Sandia prevents encoded information from being lost because of improper synchronization. Developers of the crypto synchronization loss detector are (from left) Lyndon Pierson, Tom Pratt, and Joseph Maestas (all 1934).



*(Continued from Page One)*

## R&D 'Fast Lane'

weeks, he learns. He is a member of GM's design team for braking systems, and he knows that getting commercial castings from designs can now take more than a year.

• A GM engine specialist examines a demonstration engine. It is sliced open to show how Sandians at the Combustion Research Facility use lasers and other diagnostic methods to better understand complex reactions that are usually hidden from view.

These are three of the hundreds of interactions that occurred between Sandians and GM employees last week in the Detroit suburb of Warren, Mich. An estimated 2,000 GM employees met representatives of Sandia and other national laboratories in a three-day, first-of-its-kind conference. These individual contacts may well determine the eventual success of the conference, which GM executives describe as a "moon shot" effort because of its ambitious scope.

### 'It's Going to Happen'

"Technical people like to work on problems that society views as important," says President Al Narath, who visited the conference and attended a series of meetings with GM officials. "This meeting gives us a view of auto industry problems that

### "Technical people like to work on problems that society views as important."

have been unknown to the labs." The "eyeball to eyeball" interactions ensure that Sandia researchers and individuals at other government labs will be wrestling with and solving such problems, says Al: "It's going to happen."

Sandians gave talks about subjects selected by GM, staffed an exhibit in the company's Design Dome, and met individually with GM employees involved in a variety of projects. "They offered some interesting challenges to us," says Don Peterson of Advanced Technology Development Div. 2814, who was at Sandia's exhibit and

*this month in the past...*

## Sandia LAB NEWS

*In this issue we begin a periodic glance at LAB NEWS stories from earlier decades. The artwork above was the LAB NEWS front-page "flag" during 1954 and 1955. The name SANDIA LAB NEWS replaced SANDIA BULLETIN in 1954.*

**10, 20, and 30 years ago...** Tonopah Test Range was in the news: the silver anniversary of TTR's first operations (Feb. 5, 1982), a new mobile radar for tracking high-performance targets (Feb. 4, 1972), and the opening of a 5,000-ft.-long packed-earth airstrip near the command post that eliminated the "uncomfortable 30-minute dusty, bumpy ride to the old airstrip, a converted bombing range 12 miles from the CP" (Feb. 2, 1962).

**40 years ago...** To the question "What would you most like to see developed in the next 50 years?" one secretary answered "a typewriter... that would automatically correct all errors." (A premonition of spell checkers and grammar software?) Other answers: automated accident-preventing highways, a pill to take the place of a full-course meal, and a helicopter on every roof (Feb. 15, 1952).

### Intelligent Machines Exhibit a Hit

## Sandia Technologies Attract GM Interest

Among the technologies displayed by Sandia at the GM conference in Michigan last week, much attention went to the Labs' metallurgy work, the use of computer analyses, and fast prototyping abilities. Sandia's testing capabilities, work on a number of microsensors, and aspects of the Labs' electronics manufacturing capabilities also attracted attention.

A display about Sandia's intelligent machines capabilities consistently drew crowds. "A lot of my existing contacts were rein-

forced," says Randy Brost of Software Techniques Div. 1412, "and there was significant technical interest. A lot of these people really understood the implications of what they were seeing."

Many GM employees asked tough questions of Sandians, and they seemed to like the answers they got, says Al Romig, Manager of Metallurgy Dept. 1830. "They want to work with us. We could see the excitement in their eyes. I think we had an advantage because we build things, too. They liked that."

made a professional contact that may lead to further collaboration.

GM officials compared this attempt at cooperation between their industry and national laboratories to the challenge posed by President John F. Kennedy to put a man on the moon. "This time the challenge is to ensure our national prosperity," said Donald Runkle, Vice President of GM's Advanced Engineering Staff. Though the US has abdicated production of televisions, VCRs, cameras, and other goods to foreign countries, he said, "a line must be drawn to maintain our industrial base. The domestic auto industry is not expendable."

GM researchers spent the first day of the conference spelling out obstacles and challenges. They placed these into six categories: energy, environment, safety, agile manufacturing, manufacturing validation, and ultrareliability. At the exhibition dome, a GM concept car, capable of more than 100 miles per gallon at 50 mph and weighing only 1,400 pounds, was placed on center stage.

Around the car were GM exhibits about each of the six categories. Surrounding these, 11 national labs and government R&D facilities showcased their expertise. Including Sandia, the 11 represented about 66,000 employees with an annual budget of \$22 billion.

### Breaking Down Barriers

Mike Davis, Assistant DOE Secretary for Conservation and Renewable Energy, told the conference, "GM has taken the first step to create basic cooperation between government and industry. It may not be a perfect step, but it was absolutely necessary." DOE's 1990 technology transfer budget of \$68 million is expected to grow to about

\$200 million in fiscal 1993, said Davis, "as barriers between government and industry are broken down."

Dan Arvizu, Director of Technology Transfer and Industrial Relations 4200, agrees that the move on GM's part could lead to more government-industry cooperation. "A year ago, GM wasn't

### The end result may be cooperative programs among several labs and one or more auto manufacturers.

ready to talk seriously about working together in a big cooperative effort like this," he says. "In the past year, they have re-oriented their thinking, and now they're ready to seriously talk and explore."

The next step is in-depth technical exchanges to further explore issues raised at the conference. These exchanges will address about a half dozen areas where cooperation seems likely to be productive. The end result may be cooperative programs among several labs and one or more auto manufacturers on two or three core issues.

•WKeener(3163)

### GM Conference Biggest So Far, But Not Sandia's First Encounter With US Automakers

Though the GM conference was the first large-scale meeting between an automaker and several national labs, researchers at Sandia, Livermore's Combustion Research Facility have previously had many interactions with auto company researchers and designers. Such cooperation has helped Sandians focus research on issues that concern all US automakers. For an example of a recent Sandia development that has already assisted commercial research, see "Ionization Probe in Head Gasket" (page 3).

### Sympathy

To Roberta Jaramillo (111) on the death of her mother in Albuquerque, Dec. 21.

To Ralph Goekler (9222) on the death of his mother in Oklahoma City, Dec. 27.



**UNFURLING THE FLAG** — President Al Narath gets some help from Sandia's Security Inspector of the Year, Al Luna (3435), in showing a Sandia audience a DOE flag presented to the Labs by Energy Secretary James Watkins. The flag now flies daily above Bldg. 800. Secretary Watkins gave a flag to each of the DOE lab directors at a recent "summit meeting" during which future missions of the labs were discussed.



**Easier Access to 6 Million Books, Periodicals, and Reports****Tech Library Allies with State's Other Big R&D Libraries**

More convenient access to 6 million books, periodicals, and technical reports may soon be as close as Sandia's Technical Library, says Sally Landenberger, Supervisor of Technical Library Processes Div. 3141.

At a Jan. 27 ceremony in Albuquerque, leaders of New Mexico's five largest research and educational institutions pledged to share their library resources and to provide better access to technical information. Attending the ceremony were Sandia President Al Narath and leaders of Los Alamos National Laboratory, the Air Force Phillips Lab, University of New Mexico (UNM), and New Mexico State University (NMSU).

"The organizations involved have similar missions in terms of performing interdisciplinary research to solve national problems," says Sally. "We will all benefit from providing better access to

our collective scientific and engineering knowledge base."

**Sharing Resources**

Access to information from other libraries has been available through the Tech Library for years. The new alliance should improve the mechanisms for sharing information among the state's libraries as well as encourage other institutions to request Sandia technical information.

Herb Pitts, Director of Information and Communication Services Org. 3100, says a statewide approach to managing information resources will also benefit the participants financially. "Sharing library holdings among the state's libraries should help control the cost of maintaining individual collections," he says. "This alliance will help us manage declining resources while still providing

excellent access to technical information." He says an effort will be made to reduce the number of duplicate holdings among the five libraries, especially of costly technical journals.

Currently, Sandia's Tech Library houses about 50,000 books, 26,000 periodicals, and 1 million technical reports in hard copy or on microform/microfiche. By sharing resources with the other technical libraries in the state, the five libraries can offer access to more than 6 million books, periodicals, and reports.

As part of the new agreement, each of the five libraries will bring special reference service expertise to the alliance. Sandia's reference librarians will be in a special position to provide information about nuclear sciences, testing, energy, solid-state physics, explosives, and inorganic chemistry, says Sally. Similarly, library patrons will benefit from UNM's special patent services expertise, Phillips Lab's aerospace expertise, Los Alamos' biological sciences expertise, and NMSU's agriculture expertise, for example.

Managers of the five libraries will meet quarterly to set goals and discuss progress, and working groups are now being established to tackle individual issues, such as improving access to technical journals and upgrading the mechanisms for delivering information between libraries. Library patrons will be kept informed about any new or improved services as they develop.

In the long term, says Sally, the alliance plans to implement programs that will result in shared data bases, networks, catalog access, and a more reciprocal interlibrary loan program. ●JG

SIGNING an agreement to share library resources at a Jan. 27 ceremony are (left to right) Sandia President Al Narath; Col. Peter Marchiondo, Phillips Lab commander; Averett Tombes, VP for research and economic development at New Mexico State University; Sig Hecker, director of Los Alamos National Laboratory; and Richard Peck, University of New Mexico president.

(Air Force photo)

**Turning Ideas Into Reality****Sandians Help Celebrate National Engineers Week**

An estimated 6,000 New Mexico engineers, many of them Sandians, are gearing up to celebrate National Engineers Week Feb. 16 through 22. The theme of this year's celebration, "Turning Ideas Into Reality," recognizes engineers as contributors to the quality of life, according to Roger Zimmerman (2741), president of the Albuquerque chapter of the New Mexico Society of Professional Engineers (NMSPE).

Nationally, more than 45 engineering societies and several major corporations are participating in the week-long event, which was founded in 1951 by the National Society of Professional Engineers.

Local activities begin at noon, Feb. 18, at the Four Seasons Hotel with an annual luncheon sponsored by the Albuquerque chapter of the NMSPE. Samuel Florman, famed engineer and author of books that examine the role of engineers in modern culture, will be the featured speaker. In addition, the local "Engineer of the Year" will be announced. Contact Roger on 4-7004 for tickets (\$14).

Outstanding engineering students from the University of New Mexico and the New Mexico Institute of Mining and Technology will attend the luncheon. In addition, students and teachers from local high schools will tour Sandia facilities and then attend the luncheon. Les Hill of Div. 9224 will lead the tour.

The Engineering Societies Presidents Council, an organization comprising the local chapter presidents of 21 Albuquerque engineering societies, will also host a reception for Florman the night before the luncheon, Feb. 17, at the Four Seasons (4:30 to 6 p.m.). Sandians are invited to attend. Margie Whipple (6224) is president of the ESPE.

On Feb. 20 Arlan Andrews (4500), the American Society of Mechanical Engineers (ASME)

White House Fellow assigned to the Office of Science and Technology Policy, will speak at 6 p.m. at La Posada de Albuquerque. The topic of his presentation will be "Critical Technologies." The dinner presentation is sponsored by the ASME New Mexico section. For reservations, contact Glenn Rackley (5166) on 4-8897.

On Feb. 21, UNM's College of Engineering is hosting an open house in the engineering buildings on the UNM main campus from 10 a.m. to 3 p.m. Contact the office of David Kaufman, Associate Dean of Engineering, for more information (277-5522). ●

**Take Note**

Teams of 7th- and 8th-graders from Albuquerque middle schools will compete in the annual regional mathematics competition of the national Mathcounts program on Feb. 29 from 8:15 a.m. to 2:15 p.m. at UNM's Woodward Hall. The public is invited. This regional contest is organized by the Albuquerque chapter of the New Mexico Society of Professional Engineers. Mathcounts is a nationwide program designed to answer the problem of declining math skills among students at the pre-college level. Teachers and students have been preparing for several months for the competition. They will compete against 165 other students and 21 schools, and will be tested on such topics as probability, statistics, linear algebra, and polynomials. For more information, contact Susan Gant or Lisa DeBettignies on 766-1363.

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The 1992 annual joint meeting of the American Society for Photogrammetry and Remote Sensing and the American Congress on Surveying and Mapping (ASPRS/ACSM) will be held in Albuquerque Feb. 29 through March 5. The conference's emphasis will be on the rapidly developing techniques and technologies for learning about the earth. Exhibits will feature historic maps of New Mexico and Albuquerque (including public survey maps from the 1850s and an 1889 map of Albuquerque) along with demon-

strations of modern mapping and surveying technology. For more information, contact Amy Budge on 277-3622.

**Fun & Games**

**Volleyball** — Team roster packages can be picked up at the SERP Recreation Office beginning Feb. 17. Each team's commitment to play (either oral or written) and desired league should be submitted by Feb. 27 so that schedules can be set up. Rosters are due March 6 and will be accepted only from those having made prior commitment to play. KAFB Morale, Welfare, and Recreation (MWR) has scheduled a team captains' meeting Feb. 27 at 3 p.m. at the Que Pasa Office.

The Sandia Volleyball Association (SVA) has also scheduled a team captains' meeting March 2 at 5 p.m. at the Coronado Club, Coronado Room. Discussion topics will include merging SVA with the military association for the spring season and rule changes. Practice will begin March 9 with official league play beginning March 16. For more information, call Sheila Motomatsu (9211) on 299-0515 or Edwina Kiro (3522) on 266-7605. Experienced referees are needed; if interested, call Fluff Bryant, East Gym, on 6-6415 or 6-1074.



# feed **back**

**Q:** Install more picnic tables with shade trees around buildings and the cafeteria.

**A:** Thank you for your inquiry. Facilities Directorate 7800 has only recently identified Bldg. 861 Cafeteria Landscaping Improvements as one of its top 10 projects eligible for landscape design work in FY92. The project is scheduled for this spring and will be constructed as soon as funds become available. The design will include new irrigation and site amenities, such as picnic tables,

trash cans, and benches, as well as planting improvements east and south of the cafeteria. Future expansion of the building will also be considered.

Jim Jacobs (7800)

**Q:** Work with the city to resurface and improve the shoulders on Eubank south of Central. The road is falling apart. Also, it would help to add a third northbound lane for right-turn traffic onto Southern and Central.

**A:** The city's Traffic Engineering Division currently does not have definite plans to widen or resurface the section of Eubank Boulevard between Central Avenue and the Eubank gate. Sandia and DOE have been working with the Air Force and the city on several proposals for road and gate improvements on the east side of the base. There are plans for street improvements in the future, but funding has not been authorized.

Jim Jacobs (7800)

UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS

**Deadline: Friday noon before week of publication unless changed by holiday. Mail to Div. 3162.**

**Ad Rules**

1. Limit 20 words, including last name and home phone.
2. Include organization and full name with each ad submission.
3. Submit each ad in writing. No phone-ins.
4. Use 8 1/2 by 11-inch paper.
5. Use separate sheet for each ad category.
6. Type or print ads legibly; use only accepted abbreviations.
7. One ad per category per issue.
8. No more than two insertions of same "for sale" or "wanted" item.
9. No "For Rent" ads except for employees on temporary assignment.
10. No commercial ads.
11. For active and retired Sandians and DOE employees.
12. Housing listed for sale is available for occupancy without regard to race, creed, color, or national origin.
13. "Work Wanted" ads limited to student-aged children of employees.

**MISCELLANEOUS**

MEMBERSHIP, New Mexico Camp Resort, affiliated w/Coast-to-Coast, \$500. Eaton, 869-2847.  
 SOFA SLEEPER, 8-ft.; love seat; recliner; big wood shelves; all in good condition; \$275. Jojola, 242-8459 after 5 p.m.  
 ADMIRAL REFRIGERATOR, 19 cu. ft., side-by-side, gold color, still working well, \$50. Collier, 299-0182.  
 UTILITY TRAILER, 4' x 8', w/lights & 8-in.-high sides. James, 294-6837.  
 DAIWA METAL WOOD 1-3-5, \$150; LeMaster irons, 4 through PW, \$65; top-of-the-line golf balls, \$4/doz. Campbell, 268-4925.  
 ENGAGEMENT RING, 1/5-carat diamond solitaire, \$250. Ross, 821-6366.  
 BEDROOM DRESSER SET, cherry-wood, perfect condition, 2 large dressers, nightstand, mirror, & chair, \$1,200. Hingorani, 266-6896.  
 AQUARIUM, 50-gal., stand, light, pump, filter, heater, etc., \$125. Marder, 291-8140.  
 GAS STOVE, Magic Chef, 36-in., white, \$50; tires, 2 tubeless LT 215 85R 16, \$10/ea. Padilla, 877-2116.  
 QUEEN-SIZE WATERBED, beautiful solid NM pine, bookcase headboard w/mirror, semi-waveless mattress, padded rails, new heater, \$300 OBO. Langlois, 293-3097.  
 KID'S BEDROOM FURNITURE, white vinyl over particle board, bed w/headboard bookcase & drawers, foam mattress, desk, 6-drawer chest, \$165. Phillips, 898-2565.  
 ZENITH COMPUTER, IBM-PC-compatible, 320K RAM, two 360K drives, CGA, monitor, \$200 OBO; crib mattress, like new, \$35. Ballard, 828-2504.  
 LITTLE TYKES TRAIN, \$25; Fisher Price rocking pony, \$10; Li'l Miss mobile, \$5; telephone walking toy, \$5; 25 Pampers, girl's XL, \$5. Parson, 291-8394.  
 REAL FYRE GAS LOGS, 30-in., w/automatic pilot, used only one season, burn any night, \$250. Schmidt, 823-1541.

TANNING LAMP, \$10; bathtub whirlpool, \$35; exercycle, \$27; tubular fireplace heater, \$10; 9-in. leather hiking boots, size 9-1/2, \$18. Horton, 883-7504.  
 LARGE ROLLTOP DESK, in good condition, see at 1200C Constitution NE (corner Constitution/Juan Tabo), \$200, you move. Rea, 296-4620.  
 COMPUTER, IBM-compatible, 80286, 20 MHz, 42 MB hard drive, 800 x 600 VGA monitor, DOS 4.01, software, \$950. Thomas, 293-0681.  
 KING-SIZE BED, metal frames, box spring, mattress, fabric-covered wood headboard, matching bedspread & end tables, \$200. Seamons, 291-8134.  
 HUMIDIFIER, 4-gal. Bioaire, 1 yr. old, excellent condition, \$75. Scharrer, 883-8670.  
 SNOW TIRES, 13-in. radial, studded, \$30/pr.; Sears rowing machine, \$20. Roeschke, 266-8988.  
 DELL COMPUTER, 386SX, VGA color, 5-1/4 & 3-1/2 drives, 2MB RAM, mouse, printer, needs hard drive, \$850 OBO. Karnowski, 265-2284.  
 MOTORCYCLE TRAILER, Comet, 3-bike, heavy-duty hauler, w/spare tire, \$200. Barnard, 292-5648.  
 SAVANNAH MONITOR, 2-ft. long, weighs 4 lbs., \$150/OBO. Epperson, 299-0789.  
 GYM SET, Ultra/Pak accessories, \$100; Sony VCR, SL5800, \$60; 2 Optimas Five speakers, \$50/pr.; 2 table lamps, Southwestern. Ashworth, 281-2824.  
 TWO CRIBS, w/mattresses. Ek, 291-8069.  
 SPEAKERS, Museatex Melior One, planar design, 7 mos. old, mint condition, \$1,400. Grasser, 291-0947.  
 BANJO, w/case; Cossman system; Voit rower; Super 8 sound camera; Seiko watch; Ajay exercycle, 12' x 3' pool; misc. Dobias, 822-0013.  
 FLY-FISHING ROD, 7-1/2-ft. Wright & McGill "Trailmaster" w/2-ft.-long aluminum carrying tube, Southbend "Finalist" reel, \$40 OBO. Freyermuth, 299-2053.  
 BREAD MACHINE, almost new, \$100; non-locking ski rack for compact car, \$25; misc. unused software (Word Star 5.0, Quattro Pro, etc.), cheap. Guidotti, 884-7594.  
 TIME-LIFE BOOKS: 26-vol. Science Library, \$40; 25-vol. Nature Library, \$40. Linnerooth, 299-6558.  
 TIRES: 4 Michelin MXV 205/60HR-15, 1/16-in. tread, \$20. Dippold, 821-5750.  
 EXERCISE EQUIPMENT: 2 pr. Heavy-hands (1, 2, 3# weights), Heavy-hands book, leg weights (2-1/2#), \$38/all or will sell separately. Bear, 881-7128.  
 MIKASA RONDO CHINA, Tango, service for 8, sugar & creamer, large platter & serving bowl, like new, \$100. Parker, 839-9160.  
 DOWN JACKET, beige, w/western-style suede leather decoration, Pioneer Wear brand, size ML, cost \$160 new, asking \$75. Schkade, 292-5126.  
 BUNK BEDS, made of sturdy wood construction, without mattress, \$50 OBO. Lesperance, 298-5203.  
 HEATILATOR FIREPLACE, w/glass doors, screen, grate, 12-ft. chimney, heat circulating fan, tool set, \$375. Biffle, 293-7043.  
 QUEEN SIZE SOFA SLEEPER, earth tone colors, \$225; Kirby Heritage vacuum cleaner, w/all attachments, \$150. Romero, 281-9423.

UPRIGHT FREEZER, in excellent shape, off-white, 21.2 cu. ft., \$300; Yamaha keyboard & accessories. Hueller, 296-0976.  
 GRAND PIANO, Schulz, 5 ft., walnut color, w/bench, \$1,600. Moss, 298-2643.  
 DRAFTING TABLE, car seat, air conditioner, double sink/counters/cabinets. Field, 268-0025.  
 CROSS-COUNTRY SKI PACKAGE: no-wax 205cm skis, size 41 boots (3-pin), 140cm poles, \$70. Lorence, 275-3586.  
 ADDING MACHINES, hide-a-bed couch, wood maul, fertilizer spreader, stereo record player, lawn edger, book shelves, wheelbarrow, encyclopedias, frames. Mills, 299-2130.  
 CLUB CAR LOCKING DEVICE, unused, \$20. Simon, 299-8468.  
 OAK STEREO CABINET, glass doors, solid oak storage doors, \$160; TV/VCR oak table, \$50; oak coffee table, \$85. Lott, 296-8071.  
 TRAKKER CROSS-COUNTRY SKI BOOTS, sizes 43 & 38, best offer. Spatz, 299-0410.  
 DRY WALL, 16 half-inch sheets, \$15. Cooper, 888-4150.  
 YASHICA 230AF CAMERA, 28-85mm, 70-210mm zoom lens, flash, filters, \$450 OBO. Johnson, 255-8834.  
 SEARS CRAFTSMAN 10-IN. TABLE SAW, almost new, \$200; Sears Craftsman heavy-duty 5-spd. drill press, 1/2-hp, almost new, \$150. Trujillo, 898-2853.  
 TYPEWRITER, \$25; attache case, \$5; bowling ball, bag, & shoes, \$10; coffee & end tables, \$20. Pinkerton, 255-2505.  
 MICROFILM VIEWER, Northwest model 514, very good condition, asking \$15. Chavez, 842-6374 after 6 p.m.

**TRANSPORTATION**

'83 FORD ESCORT STW 4D GL, front-wheel drive, 81K miles, \$1,600 or trade for 4x4 pickup. Jacobs, 281-9483.  
 WOMAN'S 3-SPD. BICYCLE, \$30 OBO. Meeke, 828-9825.  
 '63 CHEV. II, 4-dr. sedan, \$300. Hof, 299-0926.  
 '85 CENTAURI WINNEBAGO LUXURY VAN, 56K miles, 17-mpg hwy., 13-mpg city, unleaded regular, excellent shape, \$5,950. Key, 884-0660.  
 '84 CAMARO Z28, loaded, T-tops, low miles, many extras, excellent condition, \$5,000 OBO, trade for extended cab pickup. Apodaca, 294-5525.  
 '86 FORD F-350 TRUCK, w/sleeper, gooseneck trailer, 30-ft. lower deck, 8-ft. upper deck, \$15,000. Miller, 465-2744.  
 '87 CHEV. NOVA, 4-dr., 5-spd., AC, PS, AM/FM radio, 40-mpg, very clean inside & out, runs great. Beasley, 298-3398.  
 '87 HYUNDAI EXCEL, 2-dr. hatchback, 5-spd., AC, stereo, 64K miles, \$2,400. Roeschke, 266-8988.  
 MAN'S 10-SPD. SCHWINN BICYCLE, older style, in good condition, blue, \$45. Barnard, 292-5648.  
 '85 DODGE RAM CHARGER, 4x4, 360 V-8, loaded, excellent condition, \$7,000 OBO. Sanchez, 299-0443.  
 '90 VOLVO 740 GL, AT, AC, sunroof, heated seats, charcoal-gray interior & exterior, \$17,000. German, 281-1719.  
 '84 ISUZU IMPULSE, high mileage but good shape, has good sound system, \$2,500. Hayes, 281-9282.

'81 CITATION X-11, well maintained, 2-dr. hatchback, 109K miles, \$1,150. Seamons, 291-8134.  
 '85 NISSAN PICKUP, 4x4, king cab-ST, PS, PB, AC, AM/FM cassette, 5-spd., more, excellent condition, 67K miles, \$5,200. Luna, 255-2220.  
 '91 MAZDA B-2200 TRUCK, warranty, 5-spd., AM/FM cassette, slider window, great on gas, perfect for student, \$6,950. Epperson, 281-8691.  
 '76 BROUGHAM MOTORHOME, 24-ft., 318 V-8 engine, Dodge chassis, 48K miles, all options, book retail \$9,270, asking \$7,900 OBO. Sparks, 880-0324.  
 '85 NISSAN 300ZX COUPE, 73,800 miles, excellent condition, immaculate, new tires, alarm, T-top, \$6,200 OBO. Kozlowski, 821-8545 evenings or 344-2900.  
 '89 ISUZU PICKUP, 5-spd., AC, PS, PB, AM/FM cassette, carpet, shell, \$3,000 + take over payments, or trade for truck. Rhoden, 293-5301.  
 GIRL'S BICYCLE, 26-in., 3-spd., very good condition, includes surprisingly functional exercycle attachment, provides dual capability, \$50. Freyermuth, 299-2053.  
 '76 TOYOTA CELICA ST COUPE, 20R engine, 4-spd. manual, clean body & interior, AC, good tires, \$1,200 OBO. Aeschliman, 281-1227.  
 '89 DODGE GRAND CARAVAN LE, 23K miles, in excellent condition, loaded w/all power, AC, leather seats, more, \$13,500 OBO. Karkiewicz, 296-3101.  
 '79 MAZDA RX7, low, low, low mileage (36K), red, one owner, garaged, perfect condition inside & out, \$4,500. Robertson, 293-1007.  
 '86 STRATOS BASS BOAT, Johnson 150, Oklahoma trailer, 2 depth finders, trolling motor, canvas, many extras, \$8,500 firm. Kilgore, 296-5148.  
 '90 TOYOTA CAMRY STATION WAGON, AT, PS, PB, PW, power sunroof, tilt wheel, cruise, AC, radio, 12K miles. Wright, 256-9210.  
 '63 JEEP 4-WD STATION WAGON, rebuilt OVHC, 6-cyl., new battery, make offer. Spatz, 299-0410.  
 '71 JEEP COMMANDO, 4x4, good condition, 57K miles, \$2,500 OBO. Golden, 299-1274, leave message.  
 WOMAN'S 10-SPD.; boy's bike. Field, 268-0025.

2-BDR. HOME, Rio Rancho, 2 baths, large eat-in kitchen, fireplace, covered patio, fully landscaped, assumable 9%. Staley, 891-8460.  
 3-BDR. HOME, very nice, 1 bath, hardwood floors, 1-car garage, 1,230 sq. ft., 3707 Veranda NE, \$69,900. Newsom, 889-8972 or 298-1766.  
 ALL AMERICAN MOBILE HOME, 14' x 70', great buy, located close to base, or you can move. Lambert, 271-1372.  
 TRAILER, 10' x 50', w/attached 16 x 16 cement block room, fireplace, East Mountain area, single occupancy, \$5,000 (monthly space rental, \$100). Gudovich, 281-9080.  
 4-BDR. TOWNHOUSE, adobe accents, fireplace, assumable 8% loan, excellent condition, great buy, \$58,999. Lopez, 836-7144.  
 SCENIC 2.2 ACRES RIVERFRONT PROPERTY, w/year-round spring, 15 miles south of Pagosa Springs, Colo. Olson, 299-0483.  
 3-BDR. HOME, NE of Lomas-Tram area, immaculate, 1-3/4 baths, LR, den w/fireplace, low down, assumable, no qualify, \$72,500. Grasser, 291-0947.  
 2-BDR. TOWNHOUSE, 1 bath, 1-car garage, 1,050 sq. ft., raised ceiling, nice landscaping w/automatic sprinklers, backyard access, Coors/Quail area, \$64,000. Litts, 839-9231.  
 3-BDR. MOBILE HOME, '90 Oakcreek, 16' x 80', 2 baths, in family park, close to base. Burkinshaw, 293-7563.

**WANTED**

BUSINESS CARDS for English boy suffering from cancer, trying to be included in Guinness Book of Records for most cards collected by one person, contact Tom Sullivan in Div. 9133. Sullivan, 299-6545.  
 CROSS-COUNTRY SKI SET-UP for child, size 2, and/or woman, size 7-7-1/2. Kureczko, 281-8206.  
 COMPATIBLE GROUP for get-together in Baja in Fall '92 for beachcombing, fishing, sightseeing. Westman, 881-0471.  
 USED NINTENDO GAMES. Hunter, 865-5745.  
 WONDER HORSE, in good condition, medium or large, w/step. Stanley, 255-3083.  
 ROLLTOP DESK, in good condition. Hultine, 891-9518.  
 ALUMINUM FISHING BOAT, 14-ft. deep-vee, in excellent condition, without motor or trailer, will pay reasonable price. Freyermuth, 299-2053.  
 SOMEONE VERSATILE W/MOTOROLA 6801 or Hitachi 63701 microprocessor to assist w/a home project. Harris, 344-6640.  
 ROOMMATE to share 2-bdr. house, \$225/mo. plus 1/2 utilities, Indian School/Pennsylvania area. Golden, 299-1274, leave message.  
 MOVING BOXES, all sizes. Torres, 293-4385.

**REAL ESTATE**

3-BDR. PATIO HOME, excellent condition, 1-3/4 baths, fireplace, automatic sprinkler system for landscaping, mountain views, Sandia district. Harrison, 897-0658.  
 3-BDR. HOME, by owner, updated, 1 bath, new kitchen, separate utility room, 1 garage, backyard access, covered porch, \$72,900 negotiable. Gallegos, 293-8885.  
 5-BDR. MOSSMAN HOME, 4 baths, 3,030 sq. ft., \$149,900. Thompson, 884-4883.  
 BEAUTIFUL ACRE RIDGE LOT, prestigious Placitas Overlook subdivision, strict covenants, underground electrical, community water system, must see. Hoffman, 294-4167.  
 1-BDR. CONDO, large walk-in closet, appliances, close to UNM & KAFB, \$27,500. Gallegos, 242-8238.  
 3-BDR. MOBILE HOME, '85 model, 14' x 80', excellent condition, \$2,000 down, assume loan, approx. \$12,000 payoff. Archuleta, 877-1940.

**LOST AND FOUND**

LOST: ENGINEERING BOOK, accidentally dropped off at Tech Library, Digital Logic Design by Mano, w/orange & white cover. Langlois, 293-3097.



**Coronado Club Activities**

# It's Family Night: Bingo, Magic, and Tacos Mean Fun for Young and Old

**FIRST-RATE COMBINATION** — It's Family Night tonight, Feb. 7, and the Club is offering bingo, magic, and tacos (who could ask for more?). While the buffet is open (5-7 p.m.) kids 12 and under can get a taco, beans, rice, and a soft drink for 99¢. You over-12's get a taco, enchilada, beans, rice, green chile stew, and a tortilla for \$2.75. Kids' bingo starts at 5:30, and one of the prizes is a Nintendo Game Boy. During bingo intermission, magician Richard Searle will dazzle you with an act that includes lots of color, excitement, and audience participation.

**VALENTINE SWEETNESS** — When did you and your special one last have a chance to dance to

the Isleta Poor Boys and have a choice of scallops St. Jacques Mornay, filet mignon, shrimp scampi, or cornish game hen? Well, you'll get that chance Valentine's Day, Friday, Feb. 14. Each meal includes a glass of champagne and valentine cake. You'll love it — just remember to make those reservations (265-6791).

**ALWAYS DEALING** — Master cardsman Jim McCutcheon and many more of the Thunderbirds card group are on hand from 10 a.m. to midafternoon every other Thursday. They'd love for you to join them. The next few dates are Feb. 20 and March 5 and 19. Good fun guaranteed!

## Events Calendar

*Events Calendar items are gathered from various sources. Readers should confirm times and dates of interest whenever possible.*

**Feb. 7** — "Dia De Visitaciones," by Al Luis Lopez, Lost Tribe Productions workshop performance; 8 p.m., South Broadway Cultural Center, 848-1320.

**Feb. 7-8** — Women's Trade Fair; 8 a.m.-6 p.m. Fri., 8 a.m.-5 p.m. Sat.; Albuquerque Convention Center, 888-0855.

**Feb. 7-9** — "Dia De Los Muertos," ballet set during the annual celebration of All Soul's Day, humorous approach to problems created by an ill-fated love affair, presented by the New Mexico Ballet Company; 8:15 p.m. Fri. & Sat., 2:15 p.m. Sat. & Sun.; Popejoy Hall, 299-7798.

**Feb. 7-9** — Antique Show and Sale, antiques and collectibles; noon-9 p.m. Fri., noon-8 p.m. Sat., noon-5 p.m. Sun.; Albuquerque Convention Center, 268-5122.

**Feb. 7-22** — "Isn't It Romantic," comedy by Wendy Wasserstein about today's relationships among friends, lovers, and well-meaning mothers, involves the exploration of the contemporary feminine dilemma and the conflict between personal independence and romantic fulfillment; 8 p.m. Thurs.-Sat., 2 p.m. Sun.; Albuquerque Little Theatre, 242-4750.

**Feb. 7-March 7** — "Books Alive!" Theatre-in-the-Making brings literature to life for the whole family, books performed will be on sale at each performance; 2 p.m. Sat., CenterStage (3211 Central NE), 260-0331.

**Feb. 7-March 15** — Exhibit, "New Mexico Impressions: Printmaking 1880-1990," presents a survey of the traditional media of printmaking in New Mexico by some of New Mexico's outstanding resident and visiting artists, the first exhibition to put such a wide variety of etchings, woodcuts, lithographs, and serigraphs into a historical context; 9 a.m.-4 p.m. Tues.-Fri., 5-9 p.m. Tues.; UNM Art Museum, 277-4001.

**Feb. 7-March 15** — Exhibit, "E.I. Couse: An Image Maker for America," work of Eanger Irving Couse, one of the founders of the Taos Society of Artists and a well-known painter of Native Americans for the first three decades of the 20th century, lithographic reproductions of his paintings were used extensively by the Santa Fe Railroad for advertising; 9 a.m.-5 p.m. Tues.-Sun., admission charge, Albuquerque Museum, 243-7255.

**Feb. 7-March 29** — Exhibit, "Santiago: Saint of Two Worlds," a photo historical exhibit devoted to the history and contemporary presence of St. James, whose exploits (real or in folklore) have been celebrated in Spain, the US, and the Caribbean for centuries; 9 a.m.-5 p.m. Tues.-Sun., Albuquerque Museum, 243-7255.

**Feb. 7-April 15** — Exhibit, "Played and Printed," exhibition of lithographs and monoprints made at Tamarind Institute by art students from Albuquerque, Cibola, Rio Grande, and Valley High Schools, represents students' personal expressions after exploring social issues in selected art forms; 9 a.m.-5 p.m. Tues.-Sun., Albuquerque Museum, 243-7255.

**Feb. 8** — Fiery Food Show, showcase for chile pepper industry, cooking demonstrations, salsa competition, and the Fiery Foods Challenge; 10 a.m.-6 p.m., Albuquerque Convention Center, 873-2187.

**Feb. 8** — Toumani Diabate, African musician and

recording artist; call for time, KiMo Theatre, 764-1700.

**Feb. 9** — Chinese New Year Celebration, Chinese children folk dancers, singers, slide presentation; 2 p.m., South Broadway Cultural Center, 848-1320.

**Feb. 14-15** — Classical Concert, New Mexico Symphony Orchestra, featuring Ukrainian violinist Oleh Krysa, music includes Symphony No. 80 in D minor by Haydn, Concerto No. 2 for Violin and Orchestra by Bartok, and "Also Sprach Zarathustra" by Strauss; 8:15 p.m., Popejoy Hall, 842-8565.

**Feb. 14-16** — Shrine Circus; call for times, New Mexico State Fairgrounds, 268-9555 or 265-1791.

**Feb. 17** — "Ziegfeld: A Night at the Follies," Popejoy Hall celebrates its 26th season with the "Best of Broadway"; 8:15 p.m., Popejoy Hall, 277-3121.

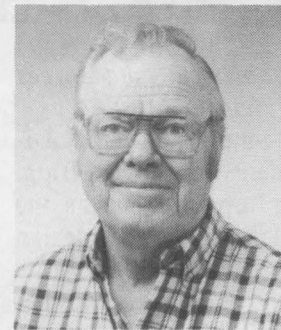
**Feb. 18** — Lithography Demonstration, by Jeff Sippel, master printer and education director at Tamarind Institute, in conjunction with "New Mexico Impressions" exhibition; 5:30 p.m., UNM Art Museum, 277-4001.

**Feb. 21-22** — Nanfoule African Folklore Ensemble, Dance & Music Concert/Lecture, music and dance traditions of West Africa and next-day workshop and drum making demonstration, planned in celebration of Black History Month, first event in the Explorations in World Music Series; Fri. concert/lecture 7:30 p.m., Sat. workshop/demonstration 11 a.m.-3 p.m.; Maxwell Museum of Natural History, 277-4404.

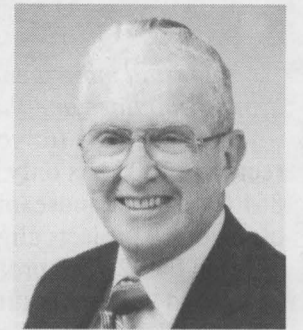
**Feb. 22** — President's Day Mardi Gras Masquerade Ball, benefit for the New Mexico Museum of Military History, music includes Big Band, Dixieland jazz, and classic rock; 7 p.m., Old Sunport Building (2920 Yale SE), 345-0037.

**Feb. 22** — Baroque Concert, Chamber Orchestra of Albuquerque performs music of Handel, Vivaldi, Bach, and Sammartini; 8:15 p.m., St. John's United Methodist Church (2626 Arizona NE), 881-0844.

## Recent Retirees



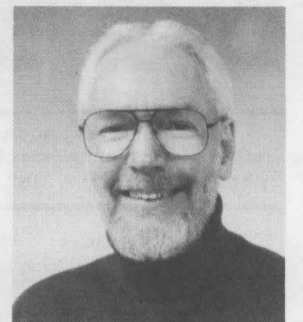
Ron Bump  
2713



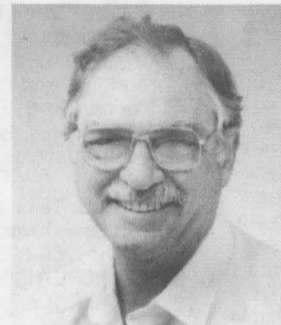
Glenn Folkins  
5164 38



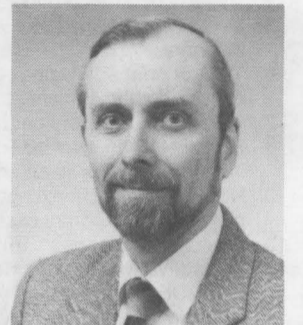
Ward Hunnicutt  
7900 41



Oscar George  
9142 28



Don Holck  
2555 33



Don Greenwoll  
9543 33

## Fun & Games

**Softball** — SERP Softball Association will hold an organizational meeting on Wednesday, Feb. 19, at 4:45 p.m. at the Coronado Club. All teams that want to sign up for this season must send a representative, indicate league preference, and obtain required registration material.

### Congratulations

To Amy and Jeff (9132) Gilkey, a daughter, Lindsay Noelle, Dec. 14.

To Lisa Cornell and Greg Poulter (1834), married in Albuquerque, Dec. 27.

To Cheryl Laird-Wilde and Steve (9214) Wilde, a son, Steven Leslie II, Jan. 19.



**FIFTEEN YEARS AGO** last month, this threesome started their Sandia careers on the same day. That's not unusual in itself, but these fellows — (from left) Mike Deveney (2371), Larry Andrews (2551), and Rick Heintzleman (2341) — had previously graduated from the Missouri Institute of Technology ("the other MIT," they call it) on the same day. If they all retire on the same day, the LAB NEWS promises to publish their photo again — maybe even on page one instead of the back page!